Prepared for
The Sac & Fox Nation Of Missouri in Kansas and Nebraska

High-Resolution Light NonAqueous Phase Liquid (LNAPL) Conceptual Site Model Assessment, Sac & Fox Truck Stop, 1346 US Highway 75, Powhattan, Kansas
March 2018

Project Number 3672-2017-10

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Conversion Factors

Inch/Ounce/Pound/PSI to International System of Units

Multiply	By	To obtain
	Length	
Inch (in.)	2.54	Centimeter (cm)
Inch (in.)	25.4	Millimeter (mm)
Foot (ft.)	0.3048	Meter (m)
	Volume	
Ounce (oz.)	29.6	Milliliters (ml)
Gallon (gal)	3.8	Liters (L)
	Pressure	
Pounds per Square Inch (psi)	6.89	Kilopascals (kPa)
	Hydraulic Conductivity	
Feet per day (ft/day)	0.0003527	Centimeters per second (cm/sec)

Temperature in degrees Celsius (°C) is converted to degrees Fahrenheit (°F) as

(°F) = (1.8 x (°C) + 32

Datum

Horizontal and vertical coordinates are referenced from the World Geodetic System 1984 [EPSG:4326].

Supplemental Information

Electrical conductivity (EC) is provided in millisiemens per meter (mS/meter).

Concentrations of chemical constituents in water are provided in either milligrams per liter (mg/L) or micrograms per liter (μg/L).

Concentrations of chemical constituents in soil are provided in either milligrams per kilogram (mg/kg) or micrograms per kilogram (μg/kg).

Concentrations of chemical constituents in vapor are provided in either milligrams per cubic meter (mg/m^3) or micrograms per cubic meter ($\mu g/m^3$).

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Summary

COLUMBIA Technologies, LLC, in collaboration with **The Sac & Fox Nation Of Missouri in Kansas and Nebraska (Sac & Fox),** conducted a high-resolution assessment of the **Sac & Fox Truck Stop,** 1346 US Highway 75, in Powhattan, Kansas (the Site) during the period of 19 to 23 March 2018.

The primary objectives of this assessment were to isolate and characterize the extent and distribution of LNAPL and to identify and describe any residual zones of petroleum acting as residual sources and any likely pathway(s) for preferential LNAPL migration to support the business goals of monetizing the long-term expense of LNAPL management. To accomplish this objective, a High-Resolution Site Characterization (HRSC) was conducted, and an updated LNAPL Conceptual Site Model (LCSM) was developed.

The updated LCSM provides a better understanding for:

(1) evaluating the risks associated with the residual LNAPL remaining at the site;
(2) setting achievable remedial action goals, and
(3) selecting or modifying effective remedial action technologies.

This HRSC was conducted in accordance with the guidelines of the Interstate Training and Regulatory Council (ITRC), *Evaluating LNAPL Remedial Technologies for Achieving Project Goals (Dec 2009)*.

The updated LCSM presented herein is based on high-resolution direct sensing measurements made by **COLUMBIA Technologies** and pertinent historic site data provided by **Sac & Fox** and their primary consultant **Terranext LLC**. Historical indications of residual LNAPL are presented in **Figure 1**.

The direct sensing data employed for this assessment are comprised of Laser Induced Fluorescence/Ultraviolet Optical Screening Tool (LIF/UVOST®) and combined Membrane Interface Probe (MIP) and Hydraulic Profiling Tool (HPT) measurements. This combined tool is referred to as a MiHpt. Direct sensing logs are presented in **Appendices D, E,** and **F**.

Direct sensing survey stations are shown in **Figure 2**. Direct sensing survey locations consist of the following:

- Eight (8) LIF/UVOST® borings
- Fifteen (15) MiHpt borings

On March 23, 2018, following the direct sensing survey high-resolution soil sampling was systematically conducted at the Site at stations where LNAPL or high concentrations

of petroleum hydrocarbons (PHCs) were identified with the direct sensing tools.

Twenty-six (26) discrete soil samples were collected from equally spaced vertical intervals through the apparent LNAPL or PHC horizon at five stations SF07, 11, 14, 16, and 18 using TerraCore® non-methanol soil samplers in accordance with EPA Method 5035. The soil samples were shipped to the ALS Environmental Laboratory to measure TPH concentrations in both the gasoline range (GRO) and diesel range (DRO) using Texas Method TX1005. These high-resolution soil sampling stations are also identified in **Figure 2**.

This high-resolution assessment of the **Sac & Fox Truck Stop** delineated residual LNAPL impacts remain at much of the site based on multiple lines of evidence that include direct sensing survey results, discrete soil sampling and analysis, and elevated BTEX concentrations in groundwater.

Gasoline range LNAPL was identified at the site covering a footprint from the northwest portion of the property eastward with residual impacts at the north, south, and eastern boundaries as shown in **Figure 3**.

Both LIF-UVOST® and soil analytical results in the C12-C28 range at station SF14 indicate the probable presence of diesel fuel at fourteen (14) to fifteen (15) feet bgs.

Residual LNAPL was measured in a vertical interval of five (5) to fifteen (15) feet below grade (bgs) on the upper operating portion of the property as shown in **Figures 4 through 8.**

Soil concentrations for TPH indicative of residual LNAPL are present within thirty (30) feet of the occupied buildings and more shallow than fifteen (15) feet below grade. These conditions exceed the preliminary screening for potential petroleum vapor intrusion into the building. Previous soil vapor measurements taken in January 2017 at a depth of six (6) feet below grade were reported by Terranext. The results included two measurements of 489,000 ug/m^3 at station SV-1 and 235,000 ug/m^3 at station SV-2. As previously reported by Terranext LLC, these levels exceed those recommended by the U.S. EPA.

The primary source of the residual LNAPL appears to be from the vicinity of the former UST enclosure to the west of monitoring well MW-6.

Multiple lines of evidence developed through this HRSC are indicative of a residual, predominantly immobile, LNAPL source zone. This implies that the overall LNAPL "footprint" is stable on a macro-scale although localized LNAPL movement into and out of pore spaces (or monitoring wells) may persist.

Most monitoring wells are installed with screen intervals in soils exhibiting low hydraulic permeability. The tops of the monitoring well screens are at times below the reported air-water interface and the bulk of the residual petroleum hydrocarbon mass. Both of these factors will likely result in groundwater concentrations for petroleum hydrocarbons being biased low. Additionally, the effectiveness of the monitoring wells for any planned groundwater treatment are diminished.

Introduction

Background and Current Conceptual Site Model (Background information *provided by Terranext LLC are in italics*)

The Sac & Fox Truck Stop is located at **1346 US Highway 75, in Powhattan, Kansas**. The Site is an operating retail gasoline station with concrete slab under the canopies, concrete over the tank basin, and remainder of the site is asphalt pavement.

On July 20, 2015, Sac & Fox reported a release of gasoline from an existing 15,000-gallon underground storage tank (UST). Due to heavy rains, approximately 63,000 gallons of impacted groundwater was pumped from the UST basin and LUST on July 10th -11th and 25th -26th, 2016.

Conclusions from the historical monitoring well installation activities, soil sampling, groundwater sampling, initial CSM development and initial soil vapor screening are as follows:

- *Based on the soil sampling, subsurface soils have been impacted above KDHE's Tier 2 non-residential RSK values at the MW4 and MW6 locations.*
- *Based on the groundwater sampling, groundwater has been impacted above KDHE's Tier 2 non-residential RSK values at the MW-1, MW-3, MW-4 and MW-6 locations.*
- *Based on the groundwater gauging, groundwater flow near the Sac & Fox Truck Stop facility is generally towards the east, towards the surface pond located approximately 600 feet east-southeast of the facility.*

Based on the monitoring well installation activities, there appears to be an orange silty sand and sand unit encountered approximately 12-20 feet bgs. This unit appears to become more prevalent to the east.

- *Based on the initial soil vapor screening, there exists the potential for soil vapor intrusion into the existing facility building.*
- *Based on the initial CSM, there exist pathways for impacted subsurface soils and groundwater to reach receptors. Potentially impacted receptors included: an ecological receptor (the pond and associated animals) down gradient (east) of the facility; commercial works on-site, and construction workers should construction activities occur at the facility.*

A soil vapor survey was performed by Terranext on January 24, 2017. Soil vapor data at near-source depth (6 feet below ground surface (bgs)) and sub-slab depth (3-feet bgs) at two locations on the south side of the existing building to determine potential vapor intrusion impacts. Soil vapor concentrations were determined to be well above screening levels calculated using U.S. EPA's MAY 2016 Vapor Intrusion Screening Level (VISL) calculator indicating potential risk to human health and environment.

Project Objectives

The overarching objective of this HRSC was to advance the development of an LNAPL Conceptual Site Model and to support the business goals of monetizing and controlling the long-term expense of LNAPL management for this Site.

To fulfill this business goal, the following technical objectives were established:

- Delineate and characterize, in high-resolution, the lateral and vertical extent of the remaining petroleum LNAPL;
- Identify higher permeability heterogeneities in the subsurface that could serve as preferential pathways for LNAPL or dissolved contaminant migration;
- Evaluate the screened intervals of installed groundwater monitoring wells in relation to LNAPL distribution and their potential for effective recovery and monitoring of the LNAPL.
- Measure LNAPL saturation and evaluate the potential for fluid recoverability.
- Perform a preliminary screening for any potential petroleum vapor intrusion
- Identify any LNAPL present at the site boundaries

The information from this high-resolution site characterization employs “scale-appropriate” survey density to define LNAPL distribution and identify migration pathways, thereby enabling evaluation of potential risks and remedial alternatives with greater certainty. This, in turn, provides the basis to optimize management strategies and monetize the long-term management of potential risks resulting from LNAPL at this Site.

Hydrogeologic Setting

Representative boring logs drilled to install monitoring wells at the Site describe the subsurface geology consists primarily of interbedded clay and silt, with traces of sand. A layer of orange silty sand appears 12-20 feet bgs. It appears that the sand content tends to increase towards the east as drilling logs from MW-3, MW-4, MW-5, MW-6 and MW-7 show a more significant orange silty sand and sand unit encountered approximately 12-20 feet bgs.

Distinctive interbedding has created the conditions for preferential deposition and retention of LNAPL as well as preferential pathways for fluid permeability.

Groundwater levels have been measured between approximately four (4) to fourteen (14) feet below ground surface (bgs) during the period January 2017 to January 2018.

Methods, Assumptions, and Procedures

This High-Resolution Site Characterization (HRSC) was conducted in accordance with the guidelines of the Interstate Training and Regulatory Council (ITRC), *Evaluating LNAPL Remedial Technologies for Achieving Project Goals (Dec 2009)*.

Planning for this High-resolution Site Characterization (HRSC) involved a review of available site documentation to develop an understanding of the existing Conceptual Site model (CSM) and indications of likely LNAPL impacts, and to assess the performance of remedial efforts implemented to date.

Locations of monitoring wells and extraction or injection wells were loaded into the *SmartData Solutions*® real-time decision support system, along with the results of recent groundwater analyses and a high-resolution assessment work plan was developed.

Direct sensing survey station locations and the locations of soil borings advanced for high-resolution soil sampling are referenced to unique station names that identify common survey or sampling locations. In this manner, collocated LIF/UVOST® borings, MiHpt survey locations, and high-resolution soil sampling locations are referenced to the same location ID that defines the common data location. For example, the station ID "L01" will be used for both LIF direct sensing data as well as high-resolution soil samples taken at that station.

Soil sampling stations were identified to the laboratory as SB01 through 05. These have been correlated to site survey stations as:

SB01 = SF14

SB02 = SF16

SB03 = SF18

SB04 = SF07

SB05 = SF11

Laser Induced Fluorescence (LIF-UVOST®)

Utilizing Laser Induced Fluorescence (LIF-UVOST®), the vertical distribution, type, and relative concentrations of LNAPL in the subsurface can be discerned at the centimeter scale. Initial LIF-UVOST® soundings were planned to be advanced in proximity to selected wells with known free phase hydrocarbons or dissolved phase benzene or BTEX concentrations indicative of LNAPL to characterize the presence and depth interval of LNAPL at suspect locations. The observed response of the LIF/UVOST® system at these locations would then serve as a reference for delineation of LNAPL present at the site.

The remaining LIF-UVOST® borings were planned to be advanced at selected locations stepping out from the estimated limits of the former UST enclosures and other potential release source areas, and adjacent to other wells with recent evidence of elevated petroleum hydrocarbon (PHC) impacts.

Membrane Interface Probe-Hydraulic Profiling Tool (MiHpt)

COLUMBIA Technologies employed two primary chemical detectors on the MIP for this assessment: a Photo Ionization Detector (PID) and a Flame Ionization Detector. The PID provides sensitivity to aromatic compounds (BTEX). The FID is a general detector useful for confirmation of high concentrations of organic compounds, including those not measured by the PID. Together, the two detectors provide a reliable measurement for the presence of residual petroleum LNAPL combined with concentrated adsorbed, dissolved, and vapor phase PHCs.

MiHpt soundings were advanced adjacent to monitoring wells where elevated BTEX concentrations were measured in recent and historic groundwater analyses, and adjacent to LIF/UVOST® survey locations where elevated response was measured. MIP detector response at these locations served to characterize primary areas of impact, and provide a baseline to interpret MIP response in potential areas of migration.

Using real-time information, initial survey results were evaluated to adjust the locations and depth of additional soundings advanced to isolate the primary LNAPL source area(s) from areas of PHC migration in each direction and for estimation of LNAPL boundaries.

Concurrently, HPT measurements were made to characterize relative hydraulic permeability and to identify potential migration pathways for LNAPL or dissolved phase PHCs.

COLUMBIA Technologies employed the Hydraulic Profiling Tool (HPT) with the Electrical Conductivity (EC) system to evaluate subsurface hydrostratigraphy in the area of the release, identifying higher permeability layers or heterogeneities that constitute preferential pathways for the movement of LNAPL or dissolved-phase contaminants, and lower permeability layers that often serve as storage zones for residual hydrocarbons.

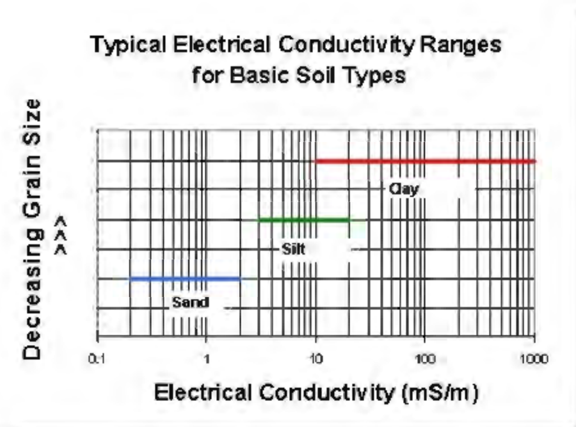
The HPT pressure logs record changes in hydraulic pressure measured directly as water is pumped into the formation at a constant rate. These logs reveal the variability and relative hydraulic conductivity of the soil.

A dipole array that measures the electrical conductivity (EC) of soil and groundwater is mounted on the tip of the MIP probe. EC measurements identify changes in the soil's electrical conductivity that can be related to changes in stratigraphy, providing insight into contaminant pathways when viewed in relation to chemical detector response.

Low EC values generally indicate coarse-grained materials (sand and gravel), while higher EC values usually indicate elevated clay content, although water chemistry and other site-specific factors influence EC response as well.

General conductivity ranges for basic soil types are presented in Table 1 below (Geoprobe, 2015).

Table 1



High-resolution soil sampling

Five direct push boring locations were selected in areas where direct sensing measurements and ground water analyses indicated that LNAPL or high levels of adsorbed or dissolved phase petroleum hydrocarbons were present. Direct push borings were collocated with LIF/UVOST® and MiHpt borings at five stations SF07, 11, 14, 16, and 18.

Twenty-six (26) discrete soil samples were collected from equally spaced vertical intervals through the apparent LNAPL horizon. Target sampling intervals were selected based on adjacent direct sensing measurements. Discrete soil samples were then collected systematically from one-foot intervals from continuous core samples using TerraCore® non-methanol soil samplers in accordance with EPA Method 5035. These high-resolution soil sampling locations are also identified in **Figure 2**.

The soil samples were shipped to the ALS Environmental Laboratory to measure TPH concentrations in both the gasoline range (GRO) and diesel range (DRO) using Texas Method TX1005. Analytical reports are presented in **Appendix H**.

Results and Discussion

Hydrostratigraphy

High HPT pressure is indicative of low permeability soils. Higher permeability is manifested by low hydraulic pressure.

The HPT borings advanced at the Site show predominantly low permeability soils, consistent with the interbedded clay and silt, with traces of sand reported in borings drilled for monitoring well installation at this Site and high-resolution soil sampling conducted for this assessment.

Interbedded zones of higher permeable soils were noted in the upper fifteen (15) feet of the Site as shown in **Figure 6**.

EC measurements were also indicative of predominantly low permeability soils

LNAPL Distribution

Figure 3 presents an estimated footprint of the LNAPL at multiple depths, based on multiple lines of evidence that include LIF/UVOST® response, MIP-PID response, elevated BTEX concentrations in groundwater, and discrete confirmation soil sampling. MIP-FID response correlates with the MIP-PID confirming these data.

The vertical distribution of LNAPL is approximately six (6) to fifteen (15) feet bgs as presented in **Figures 4 through 8** established from the multiple lines of evidence developed during this and previous investigations.

The highest measured concentrations of LNAPL determined with discrete soil sampling occurred at station SF14 just east of the diesel UST enclosure. Total Petroleum Hydrocarbons (TPH) in the C12-C28 range were measured at concentrations of 360 mg/kg and 330 mg/kg at fourteen (14) and fifteen (15) feet bgs respectively. An additional 60 mg/kg and 45 mg/kg were also measured in the C6-C12 range.

These data indicate the probable presence of diesel LNAPL at station SF14, while the remaining soil analytical results are indicative of gasoline.

Elevated MIP-PID or FID detector responses represent LNAPL, adsorbed-phase or high dissolved-phase PHCs, or a combination of these phases. Multiple instances of elevated MIP-PID and FID responses were noted between six (6) and fifteen (15) feet bgs.

The logs of direct sensing soundings made for this assessment are presented in **Appendices D**, **E,** and **F**.

High-Resolution Soil Sampling and Mobility Assesment

As discussed above, twenty-six (26) discrete soil samples were collected from equally spaced vertical intervals through the apparent LNAPL horizon at five stations SF07, 11, 14, 16, and 18 using TerraCore® non-methanol soil samplers in accordance with EPA Method 5035. These high-resolution soil sampling locations are also identified in **Figure 2**.

TPH analyses quantified GRO in six (6) of twenty-six (26) samples as presented in

Table 2. Soil sampling locations and depths, and GRO concentrations are depicted in **Figure 7** in comparison to the collocated LIF/UVOST® and MiHpt measurements.

Table 2 - Comparison of Measured TPH Concentrations to API Residual Saturation Screening Values for NAPL Mobility

RESIDUAL SATURATION SCREENING VALUES (API Bulletin No. 9, 2000)				
	SOIL	C_{sat}	C_{res}	S_r
LNAPL		mg/kg	mg/kg	cm3/cm3
Gasoline	M-C Sand	143	3,387	0.02
Middle Distillates	M-C Sand	NR	8,000	0.04
Gasoline	M-F Sand	215	5,833	0.03
Gasoline	Silt to F-Sand	387	10,000	0.05
SAMPLES COLLECTED 23 March from Sac & Fox Truck Stop, Powhatten KS				
ANALYSIS	SAMPLE ID	DEPTH (ft bgs)	RESULT (mg/kg)	
TPH	SB01-SF14	11	ND	
TPH	SB01-SF14	12	ND	
C12 TO C28	SB01-SF14	13	60	
C6 TO C12	SB01-SF14	14	60	
C12 TO C28	SB01-SF14	14	360	
C6 TO C12	SB01-SF14	15	45	
C12 TO C28	SB01-SF14	15	330	
C6 TO C12	SB02-SF16	12	190	
C6 TO C12	SB02-SF16	14	140	
TPH	SB02-SF16	16	ND	
TPH	SB03-SF18	20	ND	
TPH	SB03-SF18	21	ND	
TPH	SB03-SF18	22	ND	
TPH	SB04-SF07	11	ND	
TPH	SB04-SF07	12	ND	
TPH	SB04-SF07	13	ND	
TPH	SB04-SF07	14	ND	
TPH	SB04-SF07	15	ND	
TPH	SB04-SF07	16	ND	
C6 TO C12	SB05-SF11	8	130	
C6 TO C12	SB05-SF11	9	110	
TPH	SB05-SF11	10	ND	
TPH	SB05-SF11	11	ND	
TPH	SB05-SF11	12	ND	
TPH	SB05-SF11	13	ND	
TPH	SB05-SF11	14	ND	
TPH	SB05-SF11	15	ND	
TPH	SB05-SF11	16	ND	

On **Table 2**, above, the Total Petroleum Hydrocarbon (TPH) concentrations measured in soil samples collected from the Site are compared to published LNAPL saturation concentrations (C_{sat}), and residual LNAPL saturation concentrations (C_{res}) from API's Soil and Groundwater Bulletin No. 9 (Brost et al., 2000. *Non-Aqueous Liquid (NAPL) Mobility Limits in Soil*), a widely referenced study.

These TPH measurements validate the presence and extent of LNAPL defined at the Site through multiple lines of evidence that include high dissolved concentrations of benzene and other BTEX constituents in groundwater, LIF/UVOST® response, and MIP detector response.

Comparison of TPH concentrations measured in soil samples from the Site with residual LNAPL saturation concentrations (C_{res}) presented in **Table 2**, shows that GRO concentrations are generally less than the concentrations used as an indicator of potential LNAPL mobility in sands and silts. The trend of increasing residual saturation concentrations with decreasing grain size is noteworthy. Below C_{res}, capillary retention forces tend to limit LNAPL mobility.

TPH concentrations measured in soil samples from the Site are higher than published saturation concentrations (C_{sat}) for gasoline and middle grade distillates in sands and silts, and are indicative of residual, predominantly immobile, LNAPL. This implies that the overall LNAPL footprint is stable on a macro-scale. On a localized scale, however, LNAPL movement into and out of pore spaces (or monitoring wells) may persist, largely due to fluctuations in hydraulic conditions. That is, LNAPL may continue to exhibit micro-scale mobility within an LNAPL zone that is stable on a macro-scale.

The API screening values were developed for use in making conservative estimates of NAPL mobility, based on residual NAPL concentrations and residual NAPL saturation in unsaturated soils. The use of these values to screen for NAPL mobility presumes homogeneous soils and soil properties, which is never the case. Inherent geologic variability, macro-pores, and fractures will greatly affect the mobility and movement of NAPL. These factors must be recognized when these screening values are applied.

Concentrations above LNAPL saturation concentrations (C_{sat}) are indicative of the presence of LNAPL. Residual LNAPL saturation concentrations (C_{res}) are used as a screening limit below which LNAPL is presumed to be immobile.

Monitoring Wells and Injection Wells

Figure 8 compares the screened interval of the monitoring and recovery wells exhibiting the highest dissolved concentrations of BTEX measured in groundwater samples with the horizon of residual LNAPL developed from the multiple lines of evidence.

When compared to the distribution of soil permeability presented in **Figure 9**, it is apparent the screen intervals for these wells bridge across along both low permeability and higher permeability. The LNAPL appears to be stored in the interbedded silt and sandy soils at shallower depths. This condition will likely result in preferential recovery of clean groundwater from the higher permeable zone during pumping or extraction events while having minimal impact on the removal of LNAPL. Effective LNAPL fluid recovery will only occur in the discrete interval of LNAPL-to-water interface and only if the LNAPL transmissivity is sufficient to support recovery efforts.

Possible Evidence of Petroleum Vapor

This assessment included a screening for potential subsurface-vapor-to-air transport to the occupied facilities at Site. Soil concentrations for TPH indicative of residual LNAPL are present within thirty (30) feet of the occupied buildings and more shallow than fifteen (15) feet below grade. These conditions exceed the preliminary screening established by ITRC for potential petroleum vapor intrusion into the building.

Previous soil vapor measurements taken in January 2017 at a depth of six (6) feet below grade were reported by Terranext LLC. The results included two measurements of 489,000 ug/m3 at station SV-1 and 235,000 ug/m3 at station SV-2.

EPA has established a Reference Concentration (RfC) of 0.03 milligrams per cubic meter (0.03 mg/m3) for benzene based on hematological effects in humans. The RfC is an inhalation exposure concentration at or below which adverse health effects are not likely to occur. It is not a direct estimator of risk, but rather a reference point to gauge the potential for effects. At lifetime exposures increasingly greater than the reference exposure level, the potential for adverse health effects increases.[1]

Quality Control

Each direct sensing instrument was operated in accordance with the manufacturer's standard operating procedures and the *Standard Practice for Direct Push Technology for Volatile Contaminant Logging with the Membrane Interface Probe (MIP)* ASTM STANDARD D7352 – 07.

Performance testing was performed on each system prior to and following each survey sounding. These procedures are outlined in **Appendix C.**

A QC review of the MiHpt logs for this project did not reveal any anomalies in the MiHpt system operation.

QC measures taken by the analytical laboratory ALS Environmental Laboratory are reported in Appendix H.

[1] U.S. Environmental Protection Agency. Integrated Risk Information System (IRIS) on Benzene. National Center for Environmental Assessment, Office of Research and Development, Washington, DC. 2009.

Conclusions

1. This high-resolution assessment of the Sac & Fox Truck Stop delineated a residual LNAPL zone based on multiple lines of evidence that include LIF/UVOST®, MIP-PID and MIP-FID response, elevated BTEX concentrations in groundwater, and TPH (GRO and DRO) concentrations above soil saturation concentrations (C_{sat}).
2. LNAPL was measured primarily in a vertical interval from six (6) to fifteen (15) feet bgs across the Site as shown in **Figure 7**.
3. TPH analyses quantified GRO in six (6) of twenty-six (26) samples as presented in **Table 2**.
4. Both LIF-UVOST® and soil analytical results in the C12-C28 range at station SF14 indicate the probable presence of diesel fuel at fourteen (14) to fifteen (15) feet bgs.
5. Residual phase PHCs were present at the southern boundary at stations MW-2 and SF22 at the most recently reported air-water interface.
6. Residual phase PHCs were present at the northern boundary at stations SF15, SF16, and SF19 above the most recently reported air-water interface. Confirmation soil samples taken at station SF16 confirmed TPH concentrations indicative of residual LNAPL at 190 mg/kg at twelve (12) feet bgs. Low concentrations of PHCs were previously reported in MW-5, however, the well has since been destroyed by site activities.
7. Residual phase PHCs were present at the northeastern boundary of the facility at station SF19 above the most recently reported air-water interface. PHCs including 39 milligrams per liter (µg/L) of benzene were reported in MW-3, located further east of station of SF19.
8. TPH concentrations detected in these analyses, LIF/UVOST® and MIP response, HPT pressure logs, and the low permeability silty clay soil environment at the Site, provide multiple lines of evidence that characterize a residual, predominantly immobile, LNAPL source zone. This implies that the overall LNAPL “footprint” is stable on a macro-scale, although localized LNAPL movement into and out of pore spaces (or monitoring wells) may persist.
9. Most monitoring wells are installed with screen intervals in soils exhibiting mostly low hydraulic permeability. The top elevation of the monitoring well screens are at times below the reported air-water interface as well as the bulk of the residual petroleum hydrocarbon mass. Both of these factors will likely result in groundwater concentrations for petroleum hydrocarbons being biased low.
10. Soil concentrations for TPH indicative of residual LNAPL are present within thirty (30) feet of the occupied buildings and more shallow than fifteen (15) feet below grade. These conditions exceed the preliminary screening for potential petroleum vapor intrusion into the building. Previous soil vapor measurements taken in January 2017 at a depth of six (6) feet below grade were reported by Terranext. The results included two measurements of 489,000 µg/m3 at station SV-1 and 235,000 µg/m3 at station SV-2.

Recommendations

This report is intended to provide an improved LNAPL Conceptual Site Model (LCSM) In order to further evaluate and monetize the long-term management of LNAPL at the site. The reader is encouraged to consult the Interstate Training and Regulatory Council (ITRC). 2009. *Evaluating LNAPL Remedial Technologies for Achieving Project Goals* for viable technical options for LNAPL management going forward.

COLUMBIA Technologies recommends the following additional activities to further improve the LCSM and inform cleanup alternatives:

1. Implement vapor mitigation adjacent to the occupied building to both reduce exposure to occupants but to also enhance natural source degradation of the residual petroleum
2. Consider additional systematic high-resolution soil sampling to corroborate final delineation of the LNAPL zone, measure the LNAPL mass and saturation levels, and monitor for additional parameters needed for remedial design.
3. Review and refine the monitoring and recovery well network, based on the results of this HRSC.
4. Measure and monitor the Natural Source Zone Depletion rate at the site to evaluate the cost effectiveness of natural depletion against the cost of most aggressive and expensive measures.
5. Measure the groundwater oxidation-reduction conditions and other parameters to support the evaluation of implementing and supporting aerobic degradation processes.
6. Further evaluate remedial alternatives, to optimize and the effectiveness of LNAPL reduction and comprehensive risk management for this Site, following the guidelines of Interstate Training and Regulatory Council (ITRC). 2009. *Evaluating LNAPL Remedial Technologies for Achieving Project Goals*.

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APPENDIX A - Direct Sensing Equipment Description

LIF/UVOST® Equipment Description

The LIF system utilized for this investigation is the latest generation UVOST® system developed by Dakota Technologies, Inc. (DTI). The LIF-UVOST® system uses a high-energy laser to produce an ultraviolet light source for the detection of polycyclic aromatic hydrocarbons (PAHs).

The LIF-UVOST® system employs an excitation beam of light from a xenon chloride laser at 308 nanometers (nm), pulsed at 50 megahertz. Any residual phase PAHs present in the soil matrix will absorb this photon energy in the form of fluorescence.

This fluorescence is returned to the optical detection system via a second silica fiber optic line, measured, and recorded in real time across four 50nm wavelength bins centered at 350, 400, 450, and 500 nm.

Individual LIF-UVOST® logs consist of a primary graph of total fluorescence as a %RE test standard versus depth, an information box, and up to five waveform callouts. These callouts present the fluorescence intensity of each of the monitored wavelengths on the Y-axis [in microvolts (uV)]. The four peaks are due to the fluorescence at the four monitored wavelengths called channels. Each channel is assigned a color. Various non-aqueous phase liquids will have a unique waveform signature based on the relative amplitude of the four channels and/or the broadening of one or more of the channels.

The aforementioned wavelengths represent a common range of fluorescence associated with PAHs. Typically, the lighter fuels (jet fuel and gasoline) emit fluorescence at the shorter wavelengths – 350 and 400 nm, while heavier, less distilled compounds such as bunker fuel or diesel fuel emit fluorescence at the longer wavelengths – 450 nm and 500 nm.

LIF/UVOST® screening is performed by pushing/hammering a shock protected optical cavity (SPOC) into the soil at the target rate of two centimeters per second (0.8 inches per second). As the SPOC is advanced, the total monitored fluorescence, as well as the intensity and duration of the fluorescence at each of the four monitored wavelengths, are recorded and displayed in real-time at one-second intervals as a function of depth.

LIF/UVOST® system data is presented as a percentage of the normalized % Reference Emitter (RE) performance standard. This standard consists of a blend of Non-Aqueous Phase Liquid (NAPL) and produces a consistent fluorescence response over the four wavelengths monitored by the LIF/UVOST® system. Collected data is then presented as the %RE. Using the same RE at each location and site allows normalization of data collected over several locations, sites, or screening events. The RE standard is provided by the equipment manufacturer and is the same for all LIF/UVOST® systems currently in operation.

Any fluorescence response is normally indicative of residual phase petroleum hydrocarbons, though some naturally occurring materials such as limestone will also fluoresce to a lesser and more monochromatic degree.

MIP/EC Equipment Description

The membrane interface probe with electrical conductivity (MIP/EC) probe is approximately 24 inches in length and 1.5-inches in diameter. The probe is driven into the ground at the nominal rate of 12 inches per minute using direct push technology (DPT) system Geoprobe or equivalent.

Geoprobe Systems developed the MIP/EC probe® that contains two separate systems: the soil EC tool and the MIP. EC, MIP chemical response, MIP operating parameters, the rate of push speed and temperature are collected by the MIP/EC Field Instrument and displayed continuously in real-time during each push of the probe.

EC: Soil electrical conductivity, the inverse of soil resistivity, is measured using a dipole arrangement. In this process, an alternating electrical current is transmitted through the soil from the center, isolated pin of the probe. This current is then passed back to the probe body. The voltage response of the imposed current to the soil is measured across these same two points. Conductivity is measured in Siemens/meter, and due to the low conductivity of earth materials, the EC probe uses millisiemens/meter (mS/m). The probe is reasonably accurate in the range of 5 to 400 mS/m.

The electrical properties of soil vary by geological setting. Therefore, conductivity measurements will vary both in magnitude and the relative change from one soil type to another in each geological setting. In general, at a given location, lower conductivity values are characteristic of larger particles such as cobbles and sands, while higher conductivities are characteristic of finer sized particles such as finer sand, silts, and clays. Observed conductivities significantly higher than 400 mS/m are indicative of ionic materials other than soil. Examples include saltwater intrusion, the presence of ionic chemicals from storage or injection, or potentially soil mixtures with metallic compounds.

MIP: The MIP portion of the probe is used to create high-resolution, real-time profiles of subsurface volatile organic compounds (VOCs). The operating principle is based on heating the soil and/or water around a semi-permeable polymer membrane to 121 degrees Celsius (ºC), which allows VOCs to partition across this membrane. The MIP can be used in saturated or unsaturated soils, as water does not pass through the membrane. Nitrogen is used as an inert carrier gas and travels from a surface supply down a transfer tubing which sweeps across the back of the membrane and returns any captured VOCs to the installed detectors at the surface. It takes approximately 60 seconds for the nitrogen gas stream to travel through 150 feet of inert tubing and reach the detectors.

COLUMBIA Technologies utilizes three chemical detectors on the MIP: a Photo Ionization Detector (PID), a Flame Ionization Detector (FID) and a Halogen Specific Detector (XSD) mounted on a laboratory grade gas chromatograph (GC). The output signal from the detectors is captured by the MIP/EC data logging system installed on a laptop computer.

The PID detector consists of a special ultraviolet (UV) lamp mounted on a thermostatically controlled, low volume, flow-through cell. The temperature is adjustable from ambient temperature to 250 ºC. The 10.6-electron volt (eV) UV lamp emits energy at a wavelength of 120 nm, which is sufficient to ionize most aromatics such as BTEX and many other molecules such as hydrogen sulfide (H_2S), hexane, and ethanol whose ionization potentials are less than 10.6 eV.

The PID also emits a response for chlorinated compounds containing double-bonded carbons (e.g. halogenated ethylenes), such as trichloroethylene (TCE) and tetrachloroethylene (PCE). Methanol and water, which have ionization potentials greater than 10.6 eV, do not respond on the PID. Given that the PID is non-destructive, it is often run first in series with other detectors for multiple analyses from a single injection.

The FID utilizes a hydrogen flame to combust compounds in the carrier gas. The FID responds linearly over several orders of magnitude, and the response is very stable from day to day. This detector responds to any molecule with a carbon-hydrogen bond, but poorly to compounds such as H_2S, carbon tetrachloride, or ammonia. The carrier gas effluent from the GC column is mixed with hydrogen and burned. This combustion ionizes the analyte molecules. A collector electrode attracts the negative ions to the electrometer amplifier, producing an analog signal, which is directed to the data system input.

The Halogen Specific Detector (XSD™) was developed to address the need for a sensitive and selective detector for halogenated compounds. The XSD is sensitive to halogen atoms including bromine, chlorine, and fluorine. This detector provides high halogen selectivity, making it an effective tool for identification and measurement of halogenated compounds in environments where other contaminants are present, such as high concentrations of hydrocarbons. The XSD is used to measure concentrations of a broad range of chlorinated volatile organics and other halogenated compounds.

The XSD detector consists of a ceramic probe, platinum wire (anode) and platinum bead (cathode) mounted inside a high-temperature reactor. The detector reactor combusts the incoming sample into a stream of air and converts halogenated organics into free halogen atoms. The free halogen atoms will then react with alkali atoms on the surface of the electrically charged platinum bead, which functions as an electron emitter. When this reaction takes place, the current is measured and transmitted to the data system."

Unlike other halogen selective detectors, the XSD contains no radioactive sources and does not use organic solvents.

HPT Equipment Description

The HPT probe is approximately 24 inches in length and 1.5-inches in diameter. The probe is driven into the ground at the nominal rate of 12 inches per minute using a DPT rig.

The HPT probe was developed by Geoprobe Systems® and contains two separate systems: soil EC and the HPT. EC, HPT parameters, and temperature are collected by the HPT Field Instrument and displayed continuously in real-time during each push of the probe.

EC: Soil electrical conductivity, the inverse of soil resistivity, is measured using a Werner array arrangement. In this process, an electrical current is transmitted through the soil from two electrodes on the probe body. This current is then passed back to the probe, and the voltage response of the imposed current to the soil is measured across these points. Conductivity is measured in Siemens/meter, and due to the low conductivity of earth materials, the EC probe uses mS/m. The probe is reasonably accurate in the range of 5 to 400 mS/m.

The electrical properties of soil vary by geological setting. Therefore, conductivity measurements will vary both in magnitude and the relative change from one soil type to another in each geological setting. In general, at a given location, lower conductivity values are characteristic of larger particles such as cobbles and sands, while higher conductivities are characteristic of finer sized particles such as finer sand, silts, and clays. Observed conductivities significantly higher than 400 mS/m are indicative of ionic materials other than soil. Examples include saltwater intrusion, the presence of ionic chemicals from storage or injection, or potentially soil mixtures with metallic compounds.

HPT: The HPT portion of the system is used to create high-resolution, real-time profiles of soil hydraulic properties, which can be used to infer permeability and hydraulic conductivity. The HPT system consists of a controller, a pump, a transfer line (trunkline) which is pre-strung through the DPT rods, a pressure transducer, a permeable screen, and a field computer.

HPT screening is performed simultaneously with the EC logging. As the tool is advanced, water is pumped through the trunkline and passes into the soil through the permeable screen. The flow is regulated as to be as constant as possible. The pressure required to inject the constant flow of water into the soil, known as the HPT pressure, is monitored by the pressure transducer and recorded on the field computer in pounds per square inch (psi) versus depth. The flow rate of the water into the soil formation is also measured and recorded in milliliters per minute (mL/min) versus depth.

Static pressure measurements (dissipation tests) can also be made by stopping at discrete intervals, allowing users to determine the static water level. The dissipation test provides an estimate of the static water level, based on the hydraulic head imposed on the probe at rest as compared to the pressure measured at the surface prior to starting each location push. Dissipation tests are best to run in coarse-grained materials (sands and gravels) to assure that the local ambient hydrostatic pressure is measured quickly and accurately.

To perform a dissipation test, the HPT probe is advanced to a depth below the water table and the water flow is stopped. The pressure dissipation (reduction of pressure gradient caused by forcibly pumping water into the formation) is monitored until a stable value is observed. The dissipation usually takes the shape of a curve approaching an inflection point or stable value. The stable value is then used for the hydraulic pressure at that depth and can be used to estimate static water depth. The HPT software can also provide an estimate of K (a value used in hydrogeologic calculations) to provide an interpretation of the hydraulic permeability of the formation.

Depth in feet is measured and recorded using a precision potentiometer with a 100-inch linear range. The potentiometer is mounted on the mast of the DPT rig and a counter-weight anchored to the foot of the rig. Measurements are recorded on the down stroke of the mast, as the tooling string is pushed into the ground, and is accurate within 1/10th of an inch. The reference elevation (depth) reported for each individual boring is established by setting the data logger to zero feet with the sensing window of the downhole probe aligned with the ground surface. True boring elevations can be established with the addition of survey data if provided for in the scope of work.

APPENDIX B – Interpretation of Qualitative Direct Sensing Data General LIF/UVOST® Log Interpretation

There are three primary characteristics of fluorescence that are considered when interpreting LIF/UVOST® data. These characteristics are:

1. Fluorescence intensity - how brightly does the compound fluoresce,

2. Wavelength - what color does the compound fluoresce at, and

3. Duration - how long does the compound fluoresce at each monitored wavelength

Individual LIF/UVOST® logs consist of a primary graph of total fluorescence versus depth, an information box and up to five waveform “callouts”. In the primary fluorescence graph, depth is plotted on the Y-axis and the combined total fluorescence intensity of the four monitored wavelengths is plotted on the X-axis. Total fluorescence intensity is presented as a percentage of the RE standard. Given that various PAHs fluoresce at differing intensities, there are several compounds that fluoresce brighter than the RE standard; therefore, the total %RE can exceed 100. Total fluorescence intensity is typically proportional to concentration and responds linearly as concentration increases.

While the magnitude of response of a LIF system may be indicative of the amount of contamination present, the system response should be considered only qualitative and not quantitative. The depth of the response is highly accurate and may be relied upon to guide additional data gathering such as soil and/or groundwater sampling. Furthermore, the depth of the response in one boring location does provide a reliable indicator of a potential source(s) of contamination, particularly when compared to results from adjacent boring locations.

Waveform callouts are presented along with the left-hand side of the primary graph. These callouts present the fluoresce intensity of each of the monitored wavelengths on the Y-axis [in microvolts (μV)] and the duration of fluorescence of each wavelength on the X-axis. No scale is given along the X-axis, however; it is a consistent 320 nanoseconds wide. The four peaks are due to the fluorescence at the four monitored wavelengths called channels. Each channel is assigned a color. Various NAPLs will have a unique waveform signature based on the relative amplitude of the four channels and/or the broadening of one or more of the channels. Callouts are selected by the operator and typically correspond to peaks on the primary graph.

The fill color of the response on the primary graph is based on the relative contribution of each of the four channels’ area versus the total waveform area. This allows the viewer to discern different substances at different each depth interval based on the fill color.

See **Appendix H**: LIF/UVOST® Response to Various Saturated Products on Wet Sand for the expected wavelength signature for common compounds.

General MIP/EC Log Interpretation

Each MIP/EC log includes five separate graphs of data. The Y-axis on all graphs is depth. The first graph displays the EC, measured in mS/m. Small soil conductivity values are indicative of coarser grained particles, such as sands and silty sands, and larger soil conductivities are indicative of finer-grained particles, such as clays and silty clays. The next three graphs are displays of measures of chemical detector response: PID, FID, and XSD measured in µV. These graphs are a linear scale and provide a relative comparison of total detector response between boring locations. The fifth graph displays the temperature of the MIP/EC probe as it is pushed into the subsurface.

General HPT Log Interpretation

Each HPT log, presented on an individual scale, includes three separate graphs of data. The Y axis on all graphs is depth. The first graph displays HPT pressure in psi and flow rate measured in mL/min. In general, higher HPT pressure readings and lower flow rates indicate lower soil permeability, while lower HPT pressure readings and higher flow rate readings indicate higher soil permeability. The second graph shows estimated K value, in feet/day, indicating the hydraulic permeability of the formation. The static groundwater level is also displayed on the graphs. The third graph displays the EC, measured in mS/m. Lower soil conductivities are indicative of coarser grained particles, such as sands and silty sands, and higher soil conductivities are indicative of finer grained particles, such as clays and silty clays.

The HPT pressure and electrical conductivity can be used to identify hydraulic permeable layers, confining units and preferential migration pathways. This information is useful for creating contaminate fate and transport models, selecting monitoring well location and screen intervals, and targeting zones for remedial injections.

Interpreting LIF/UVOST® and Comparison to Laboratory Analyses

Generalized correlation between LIF/UVOST® and laboratory analytical results can be inferred, but cannot be viewed as a linear comparison. LIF/UVOST® response and laboratory results are collected, analyzed and reported in different units and by different procedures, so correlation is not an exact one-to-one comparison. The LIF/UVOST® uses a process whereas a 2D soil surface is exposed to excitation light, and any fluorescent light emitted is analyzed at the ground surface. Soil and groundwater results involve the collection of a soil core, extraction of sub-sample at the surface, and then transporting them to a laboratory for extraction and analysis. These processes are different by definition.

Interpreting MIP Results and Comparison to Laboratory Analyses

A typically configured MIP system is effective at profiling the relative distribution of certain VOCs and relative soil types versus depth. The typical MIP system will detect VOCs with boiling points of 121 ºC or less; with vapor pressures above approximately 0.14 psi; and with non-polar hydrophobic compound structures. The sensitivity or in-situ detection level of a MIP system is dependent on many different factors. **COLUMBIA Technologies**' systems and protocols are standardized to provide reliable and comparable detection and logging of chlorinated VOCs (CVOCs) on the order of 200 ppb in-situ concentrations. Petroleum based VOCs are reliably logged at 1 ppm in-situ concentrations. Each of **COLUMBIA Technologies**' MIP system configurations is performance tested prior to use and if requested, MIP systems may be specially configured for atypical compounds of concern (COCs) and site conditions.

An understanding of the principles of operation and performance of the configured MIP detectors is essential to properly interpret the MIP log results. For example, a CVOC with an ionization potential greater than 10.6 eV will respond on the XSD detector but not on the PID equipped with a 10.6 eV lamp. A hydrophilic compound such as an alcohol or ketone will normally be scrubbed out of the MIP gas stream by the MIP Membrane and the installed dryer and never reach the detectors. A CVOC with a small number of chlorine atoms such as vinyl chloride or DCE will have a lower response on the XSD than a CVOC containing three or four chlorine atoms. Properly configuring and testing the MIP system for the site-specific COCs prior to use can overcome each shortfall in detector or system performance. Additionally, the in-field performance tests performed before and after each boring are critical to monitor the performance of the MIP system from the membrane through to the data logging system.

Generalized correlations between MIP response and laboratory sample results can be inferred, but cannot be viewed as a linear comparison. MIP response and laboratory results are collected, analyzed and reported in different units and by different procedures, so correlation is not an exact one-to-one comparison. For example, not all VOCs present and analyzed in laboratory instruments with compound separation are detected and measured by a typical MIP system. The MIP process uses a membrane extraction process from a heated zone of varying subsurface matrix of soil, water, and/or vapor. Soil and groundwater results involve the collection of a sample, extraction of sub-sample at the surface, and then transporting them to a laboratory for further extraction and analysis. These two processes are different by definition.

Unusual or invalid responses on the MIP system can result from malfunctions such as carrier or makeup gas leakage, gas flow blockage, heater failure, and carryover of water vapor or excessive chemical saturation. Each MIP detector will respond differently to each of these malfunctions. The most common cause of false positive responses for CVOCs is water carryover or blockage of carrier gas flow. The most common causes of false negative are improperly adjusted gas flows or leakage and inoperative detectors. **COLUMBIA Technologies**' field geochemists are trained to recognize these problems and to take the appropriate corrective action in the field.

APPENDIX C – Quality Control Procedures

LIF/UVOST® System Performance Test

As a quality control check, the LIF/UVOST® system response is evaluated prior to and upon completion of each LIF/UVOST® screening location. This evaluation is completed using a RE that consists of a blend of NAPL and produces a consistent fluorescence response over the four wavelengths monitored by the LIF/UVOST® system. Collected data is then presented as a percentage of the RE. Using the same RE at each location and site allows normalization of data collected over several locations, sites, or screening events. The RE standard is provided by DTI and is the same for all LIF/UVOST® systems currently in operation.

In addition to obtaining a baseline RE for each location, the background reading of the LIF/UVOST® system is electronically recorded prior to insertion into the soil. This background reading is required to be less than 0.5% of RE prior to the start of any testing. The background during tool advancement typically stays at or below the surface background reading – giving confidence that any increases in fluorescence are "true" readings and not fluctuations or variations in background.

MIP/EC System Performance Test

As a quality control check, the MIP system response is evaluated prior to and upon completion of each MIP location. An aqueous phase performance test is performed using specific compounds designed to evaluate the sensitivity of the particular probe, transfer line and detector suite to be used. The resulting values are recorded and compared to predetermined values.

The EC dipole is also evaluated using a brass and stainless steel test jig, resulting in known values of 55 and 290 mS. Results must fall within 10% of the expected values; otherwise, corrective action must be performed.

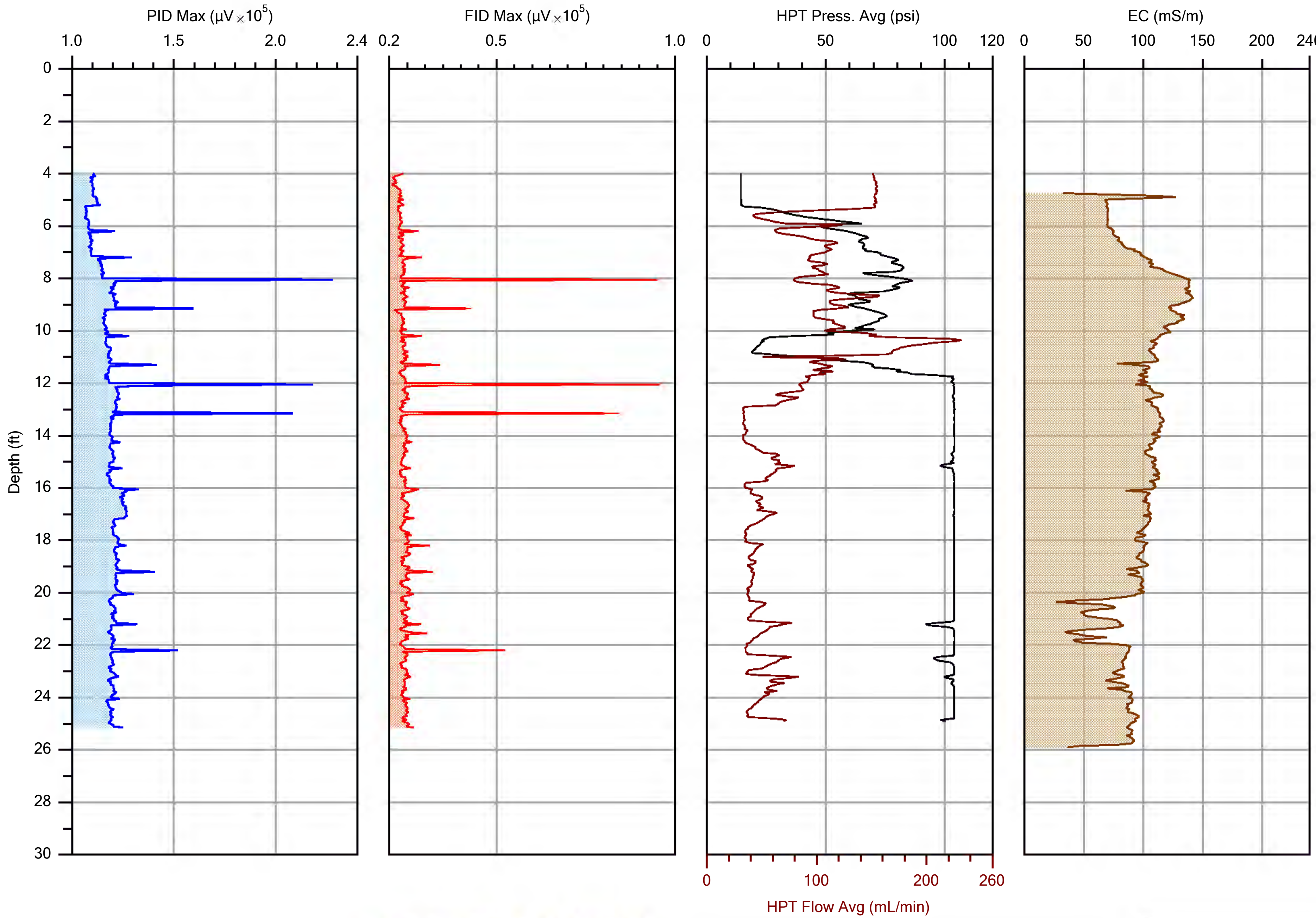
HPT System Performance Test

The EC Wenner is also evaluated using a Wenner Array test jig, to test the probe for isolation and continuity. Results must fall within 10% of the expected values; otherwise, corrective action must be performed.

The HPT sensor is also evaluated using static (no flow) and dynamic (with the flow at approximately 150 milliliters per minute hydraulic pressure measurements at two different head elevations, 6.0 inches apart. The difference for each test must be 0.2 psi, +/- 10%; otherwise, corrective action must be performed.

APPENDIX D – Data Logs for Membrane Interface Probe/EC with Hydraulic Profile Tool (MiHpt)

Individual Scale



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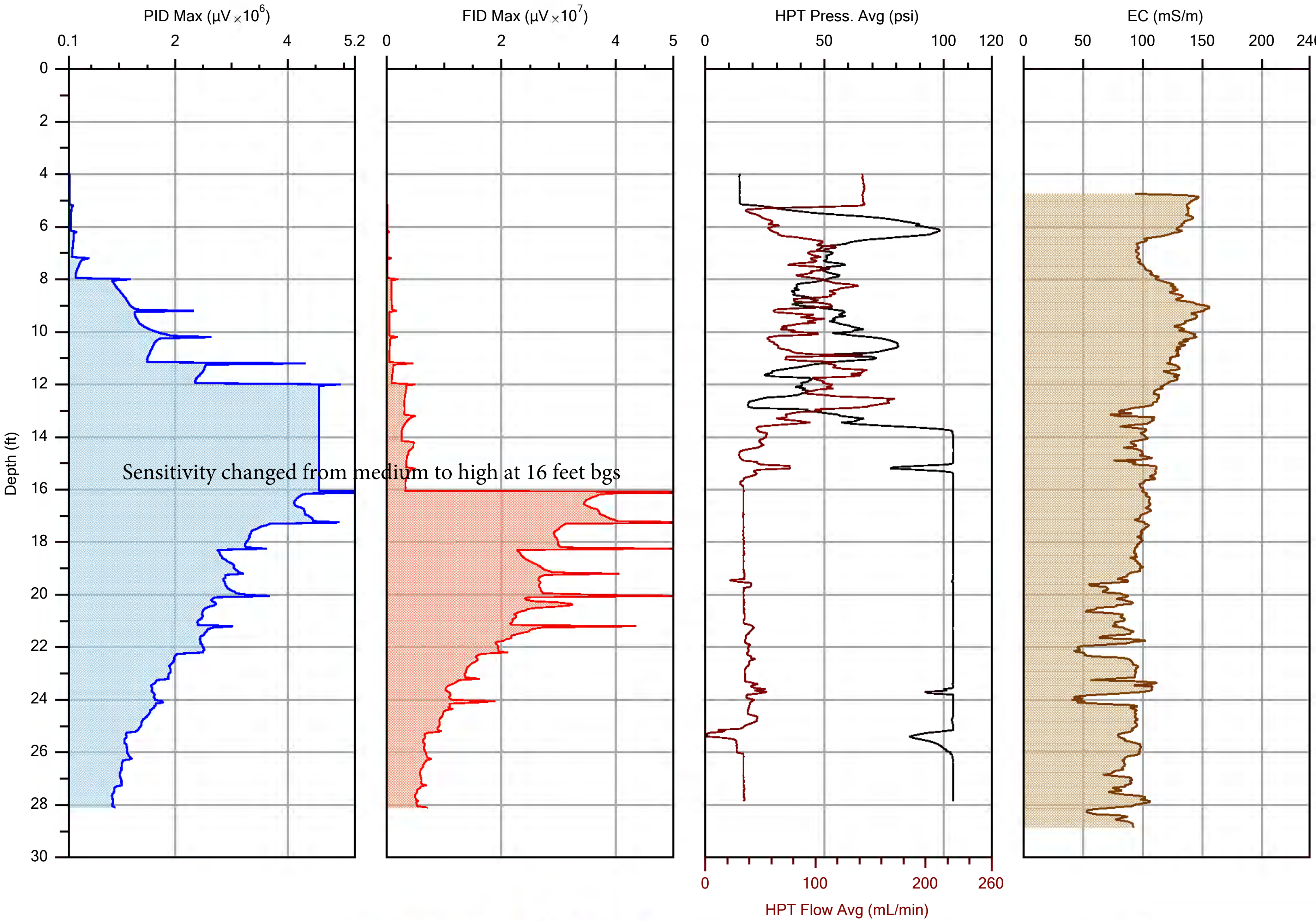

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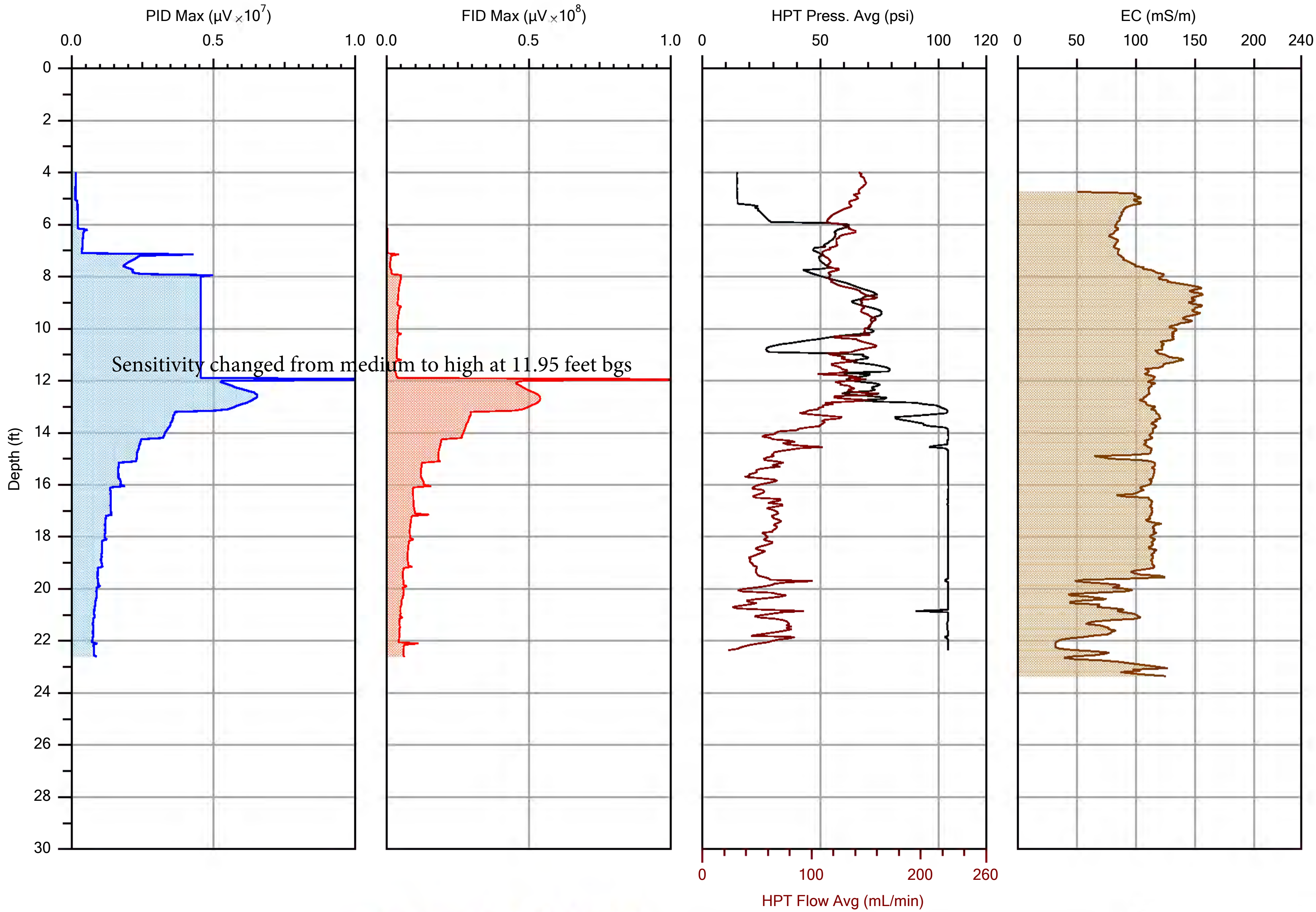

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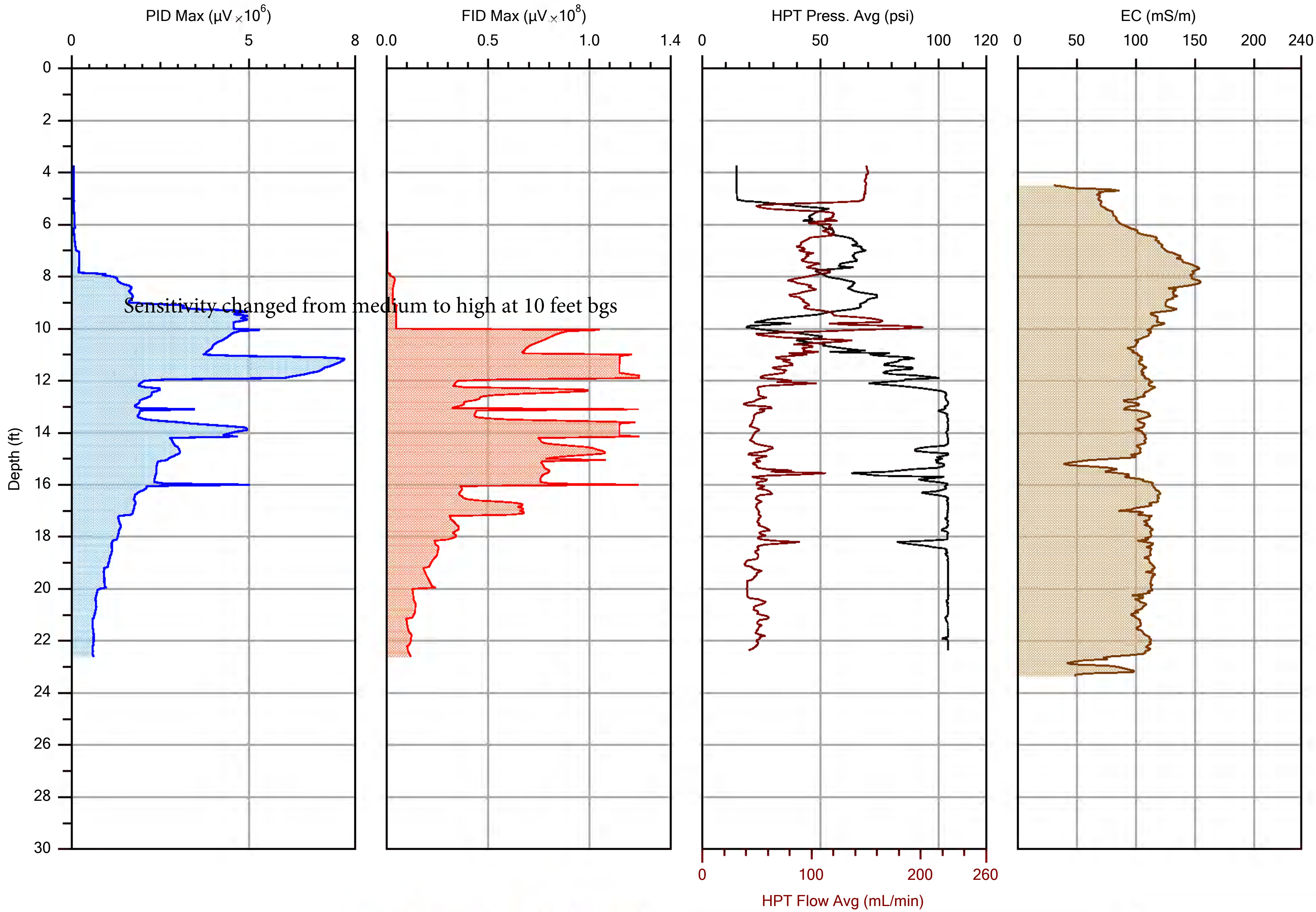

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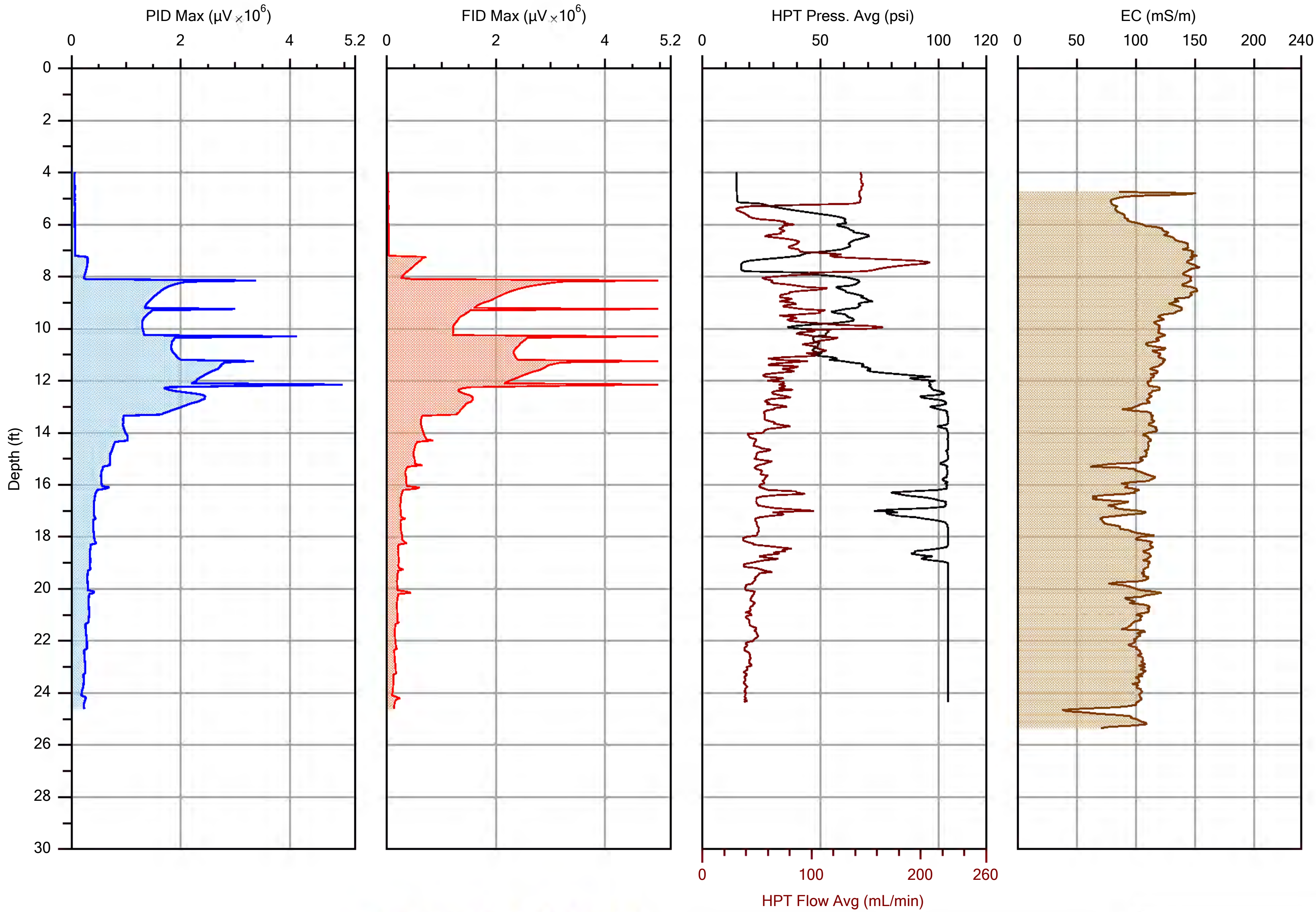

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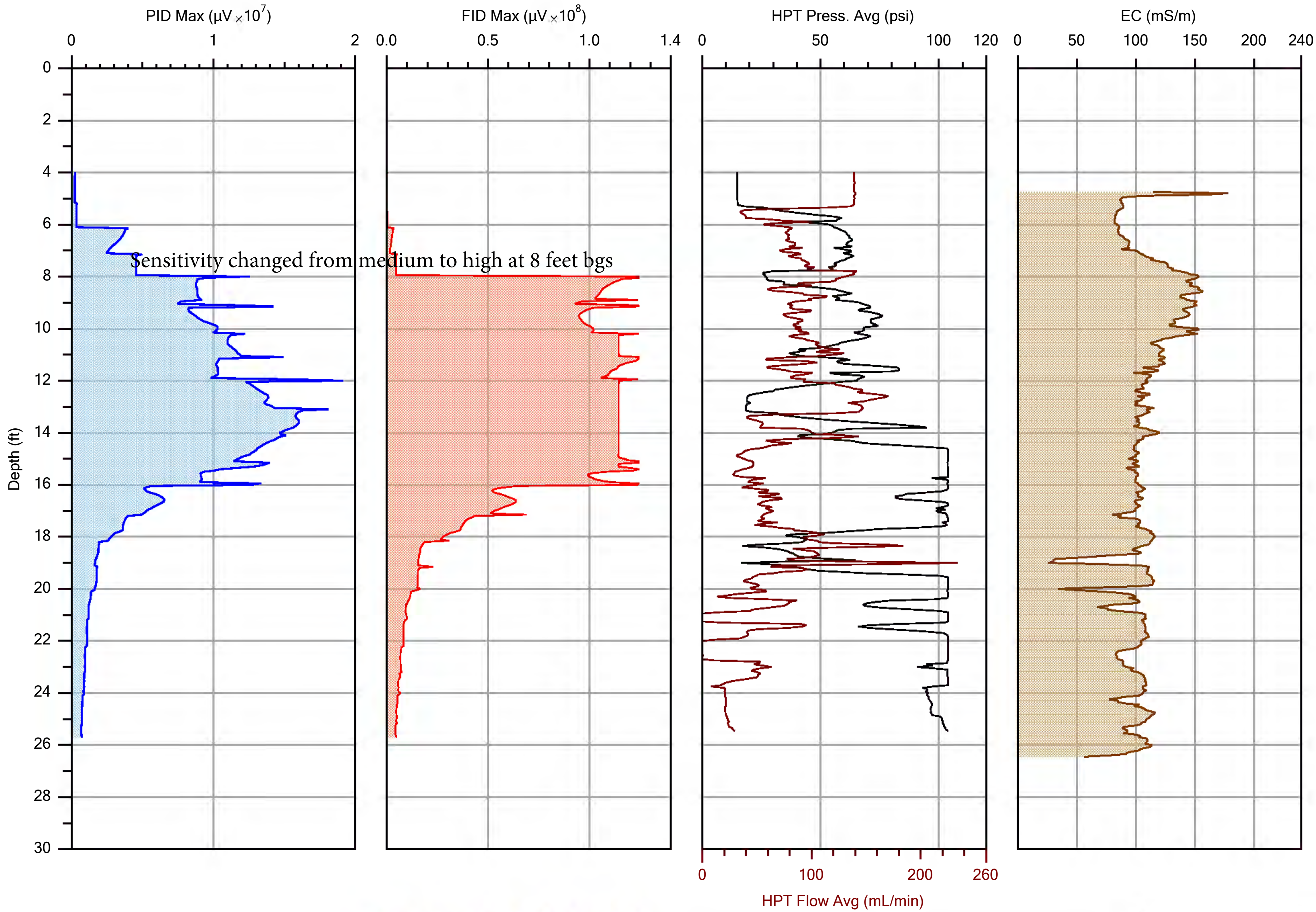

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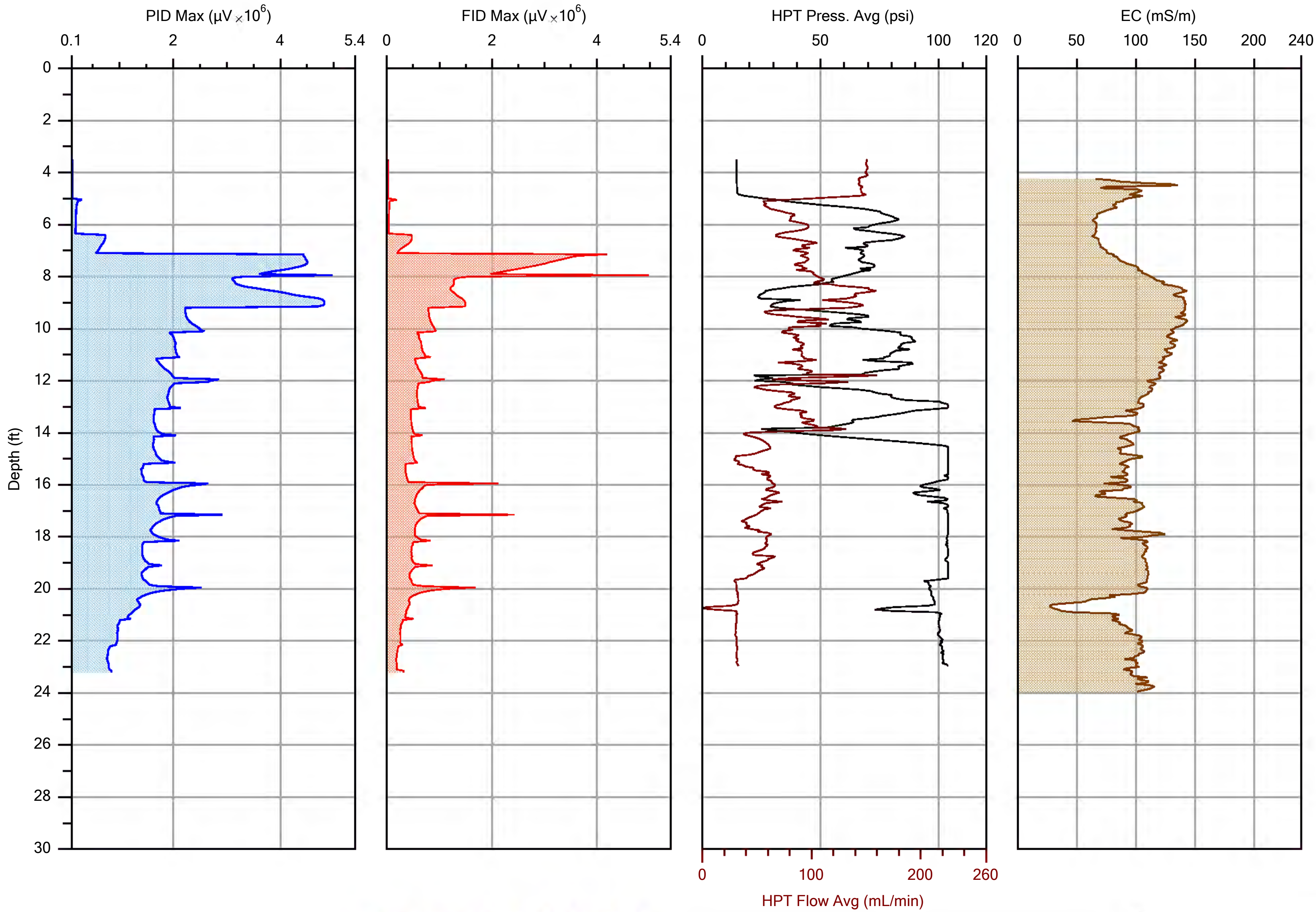

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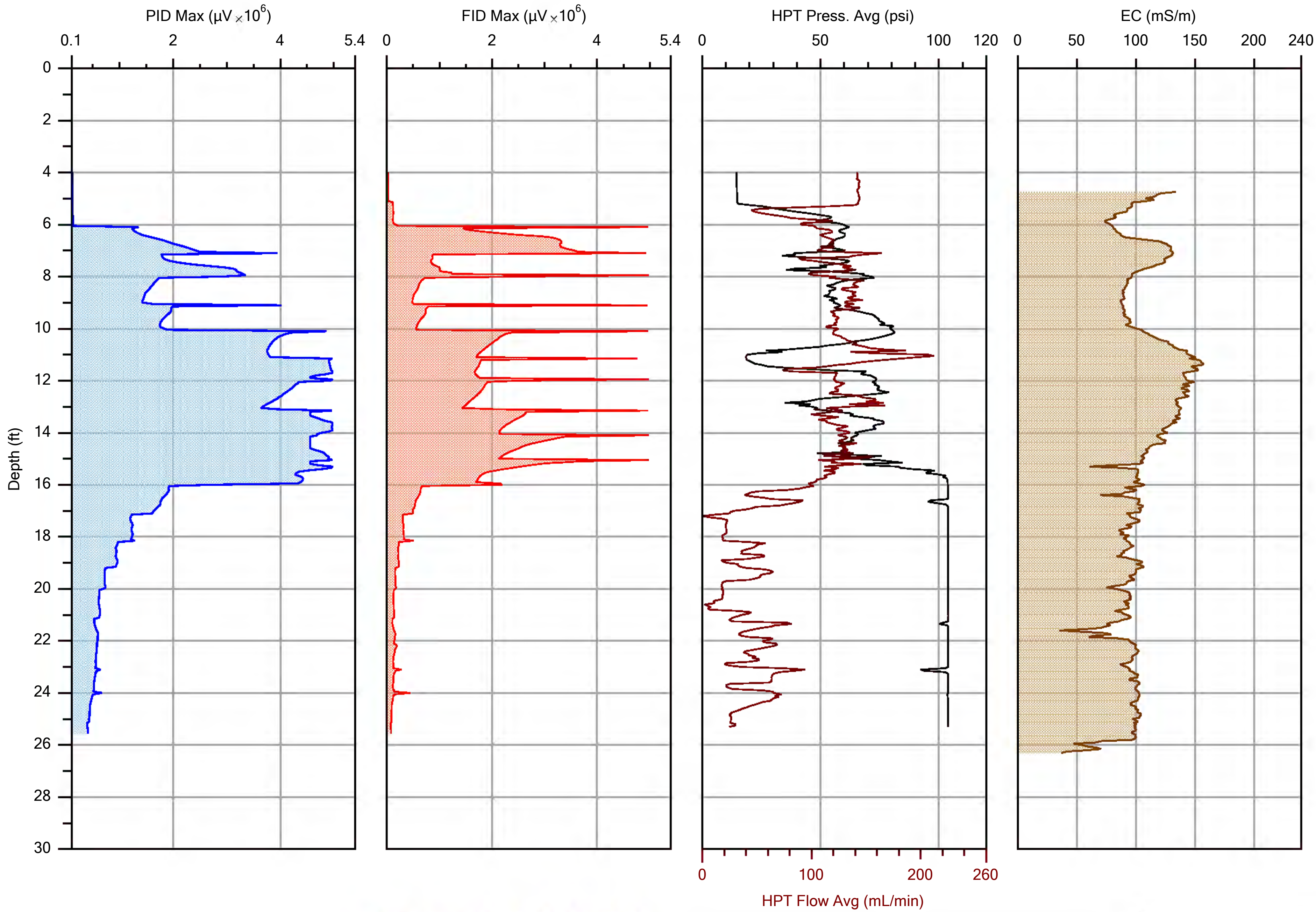

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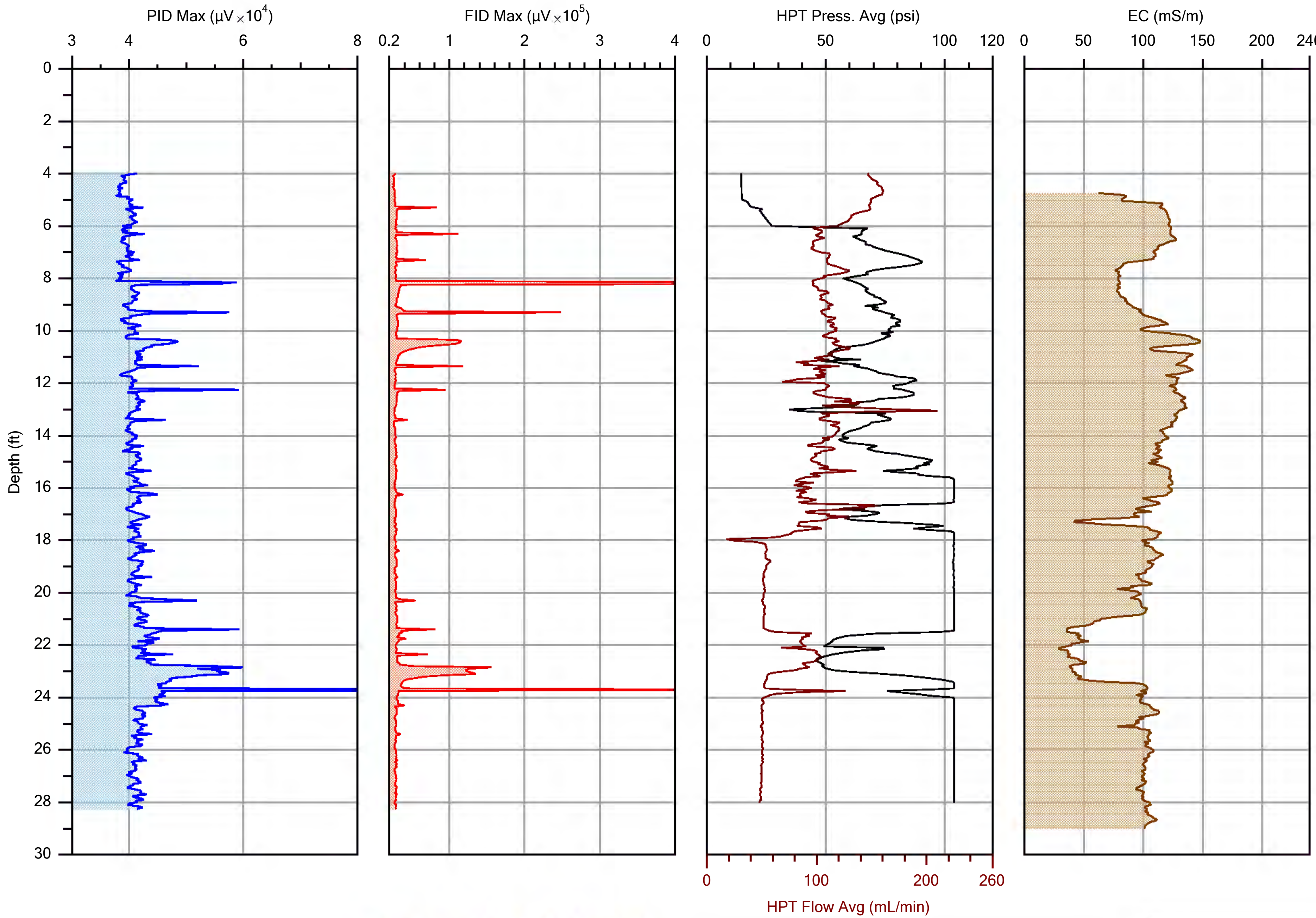

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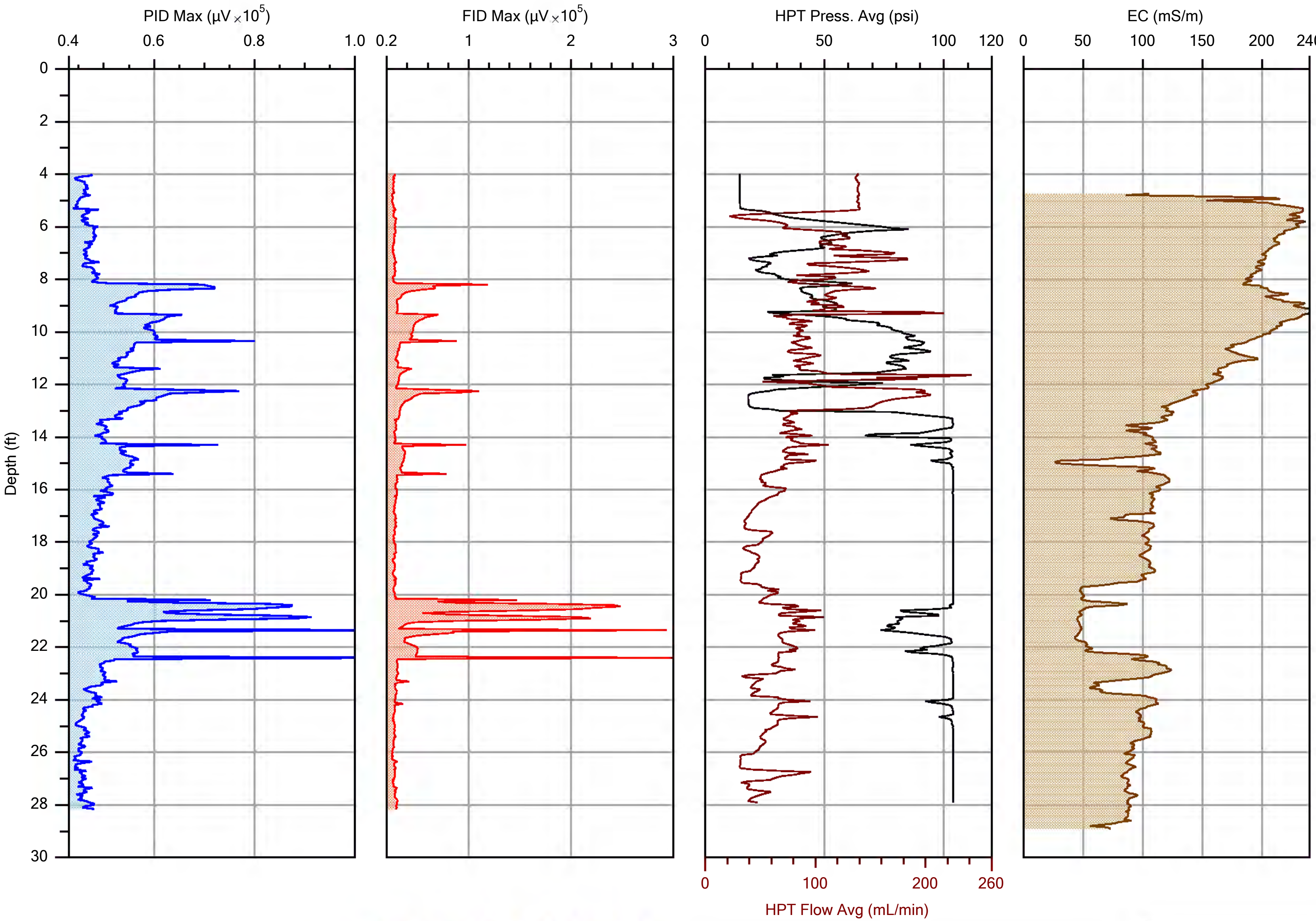

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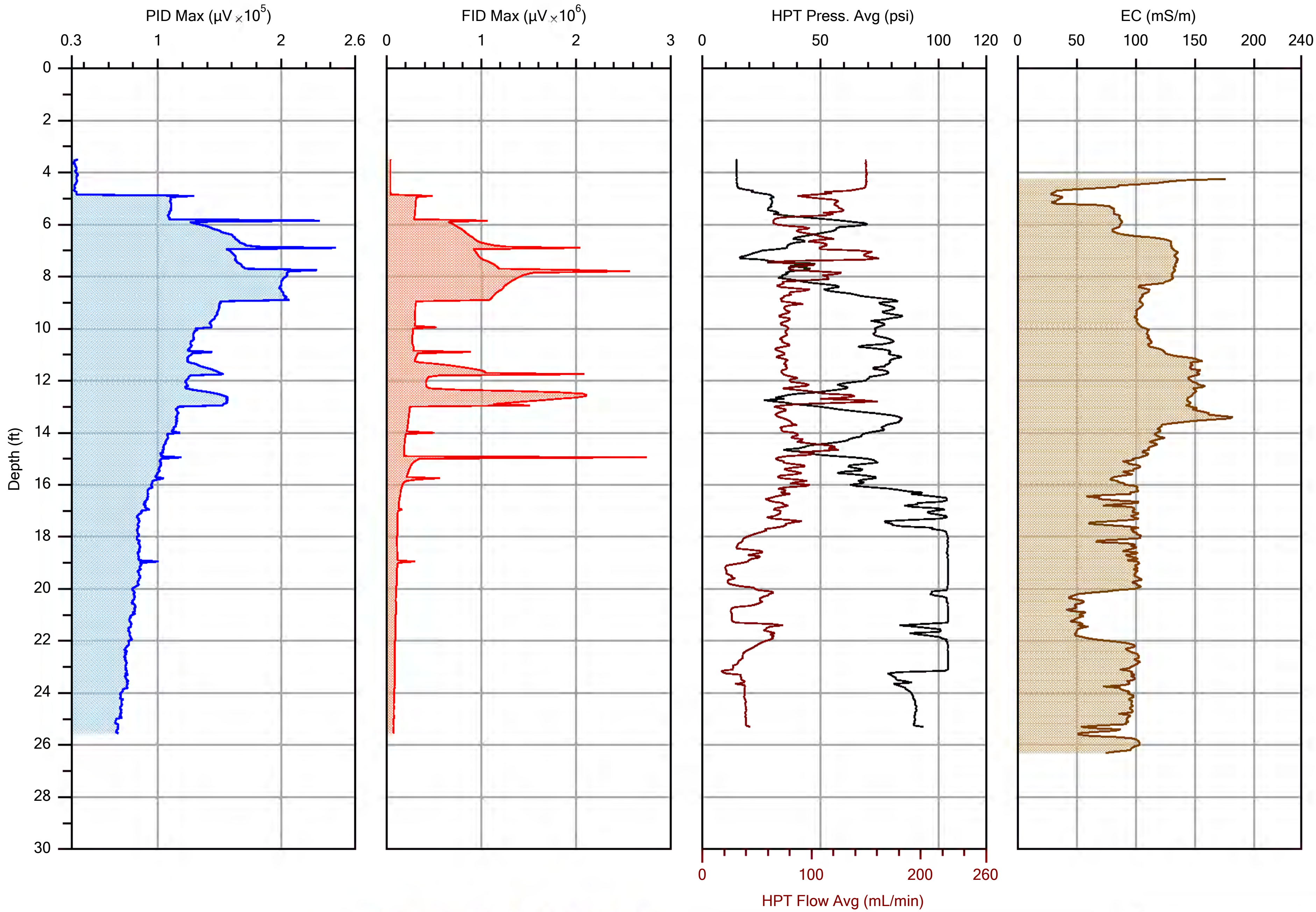

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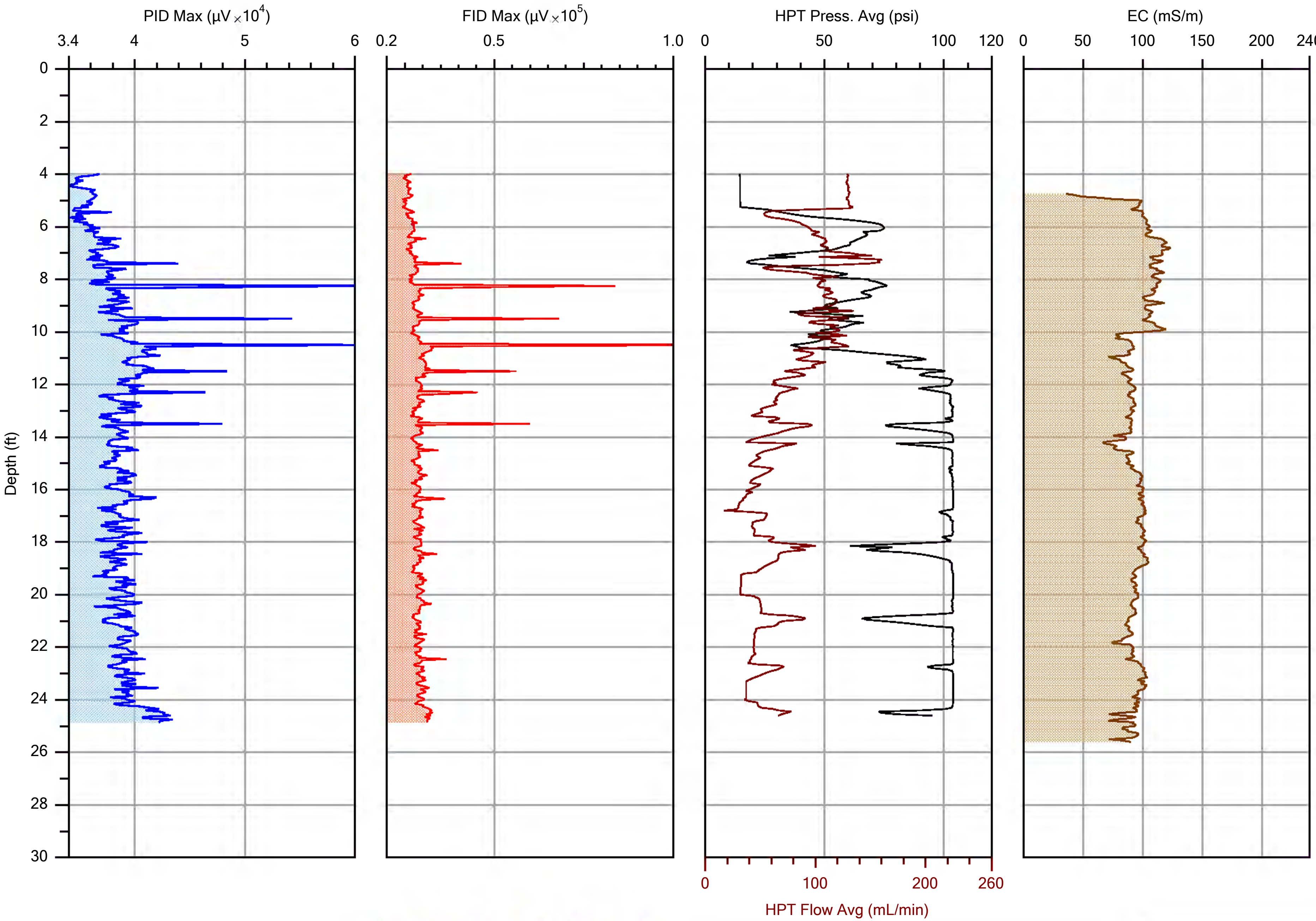

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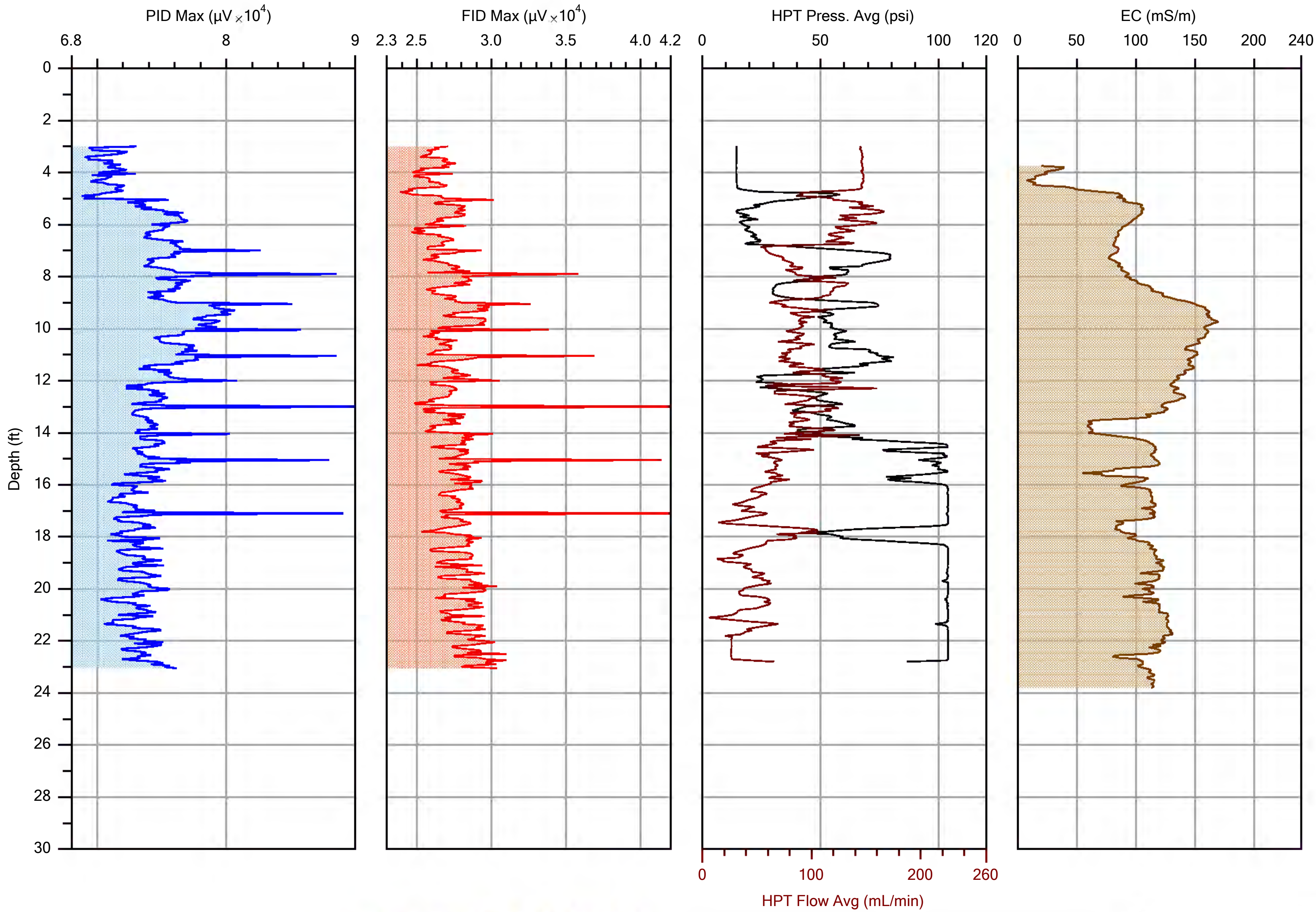

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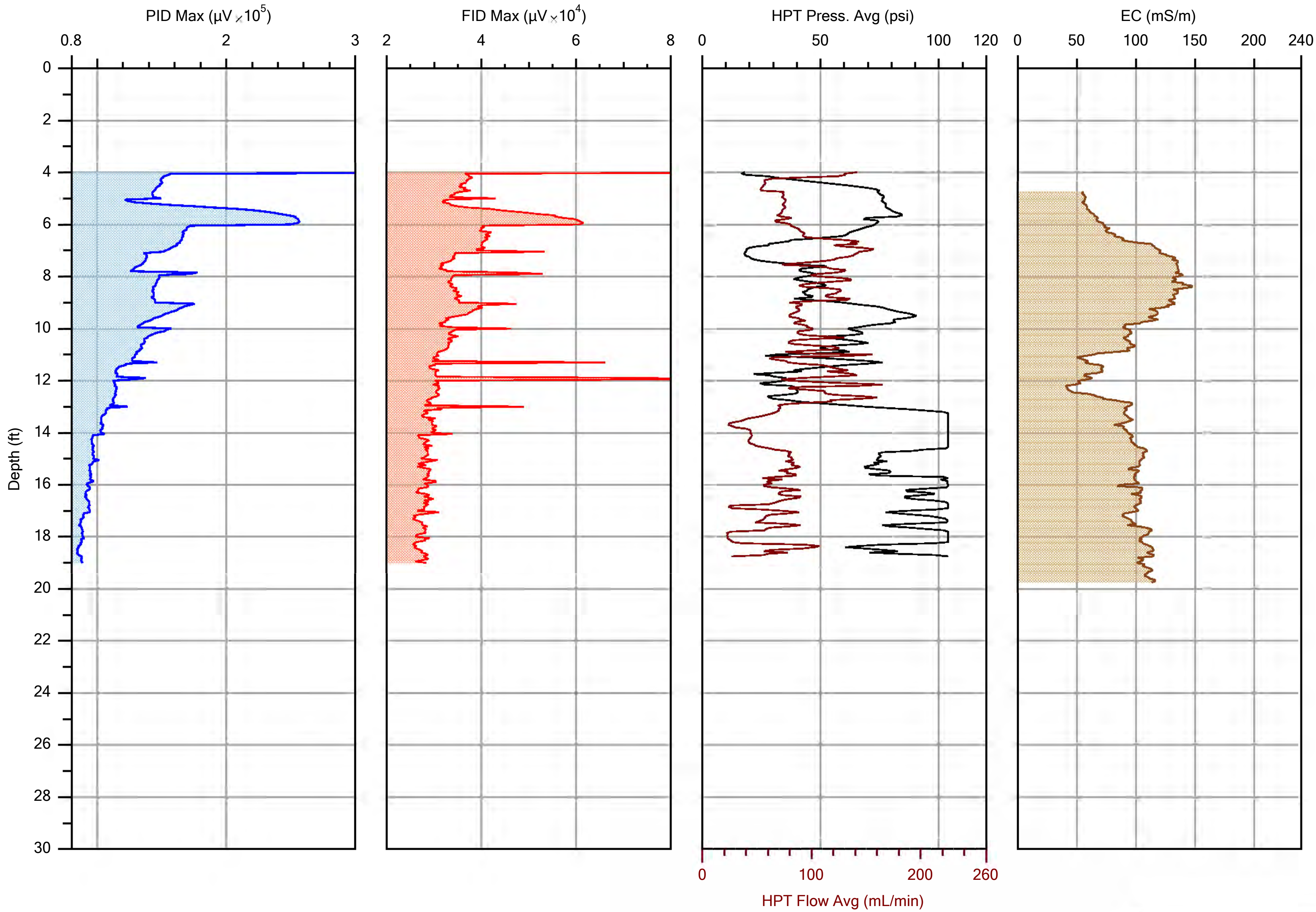

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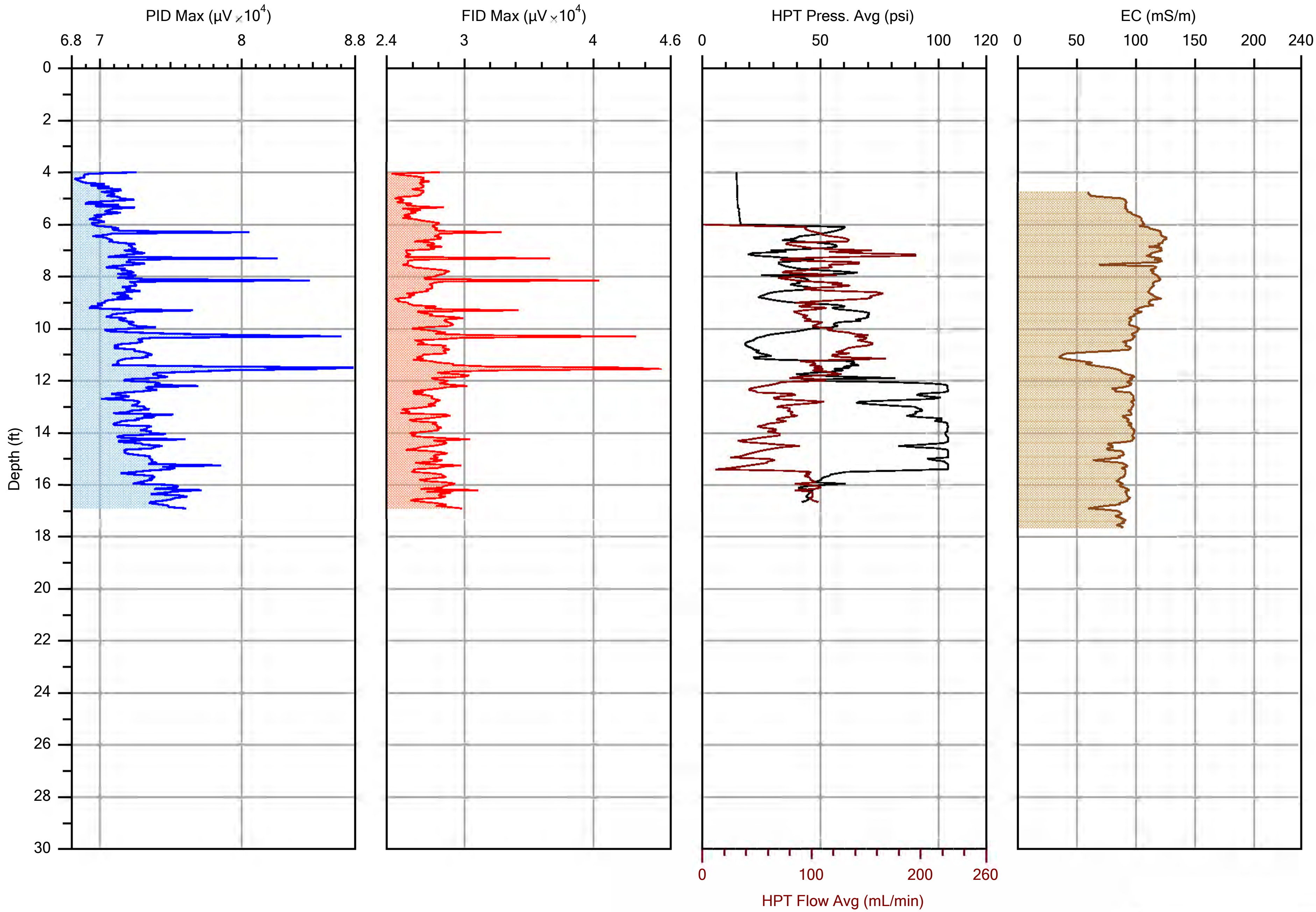

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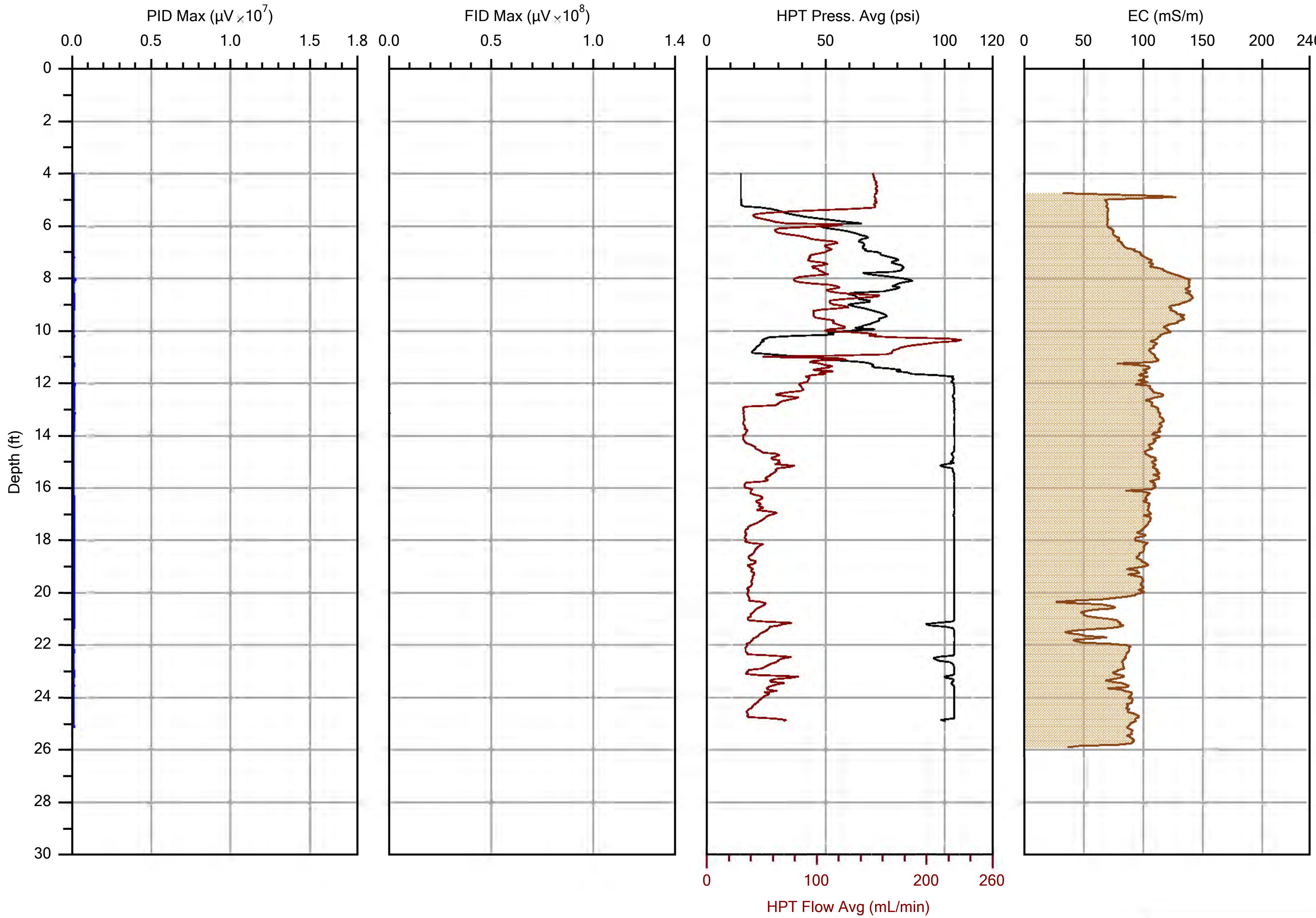
APPENDIX E – Data Logs for Membrane Interface Probe/EC with Hydraulic Profile Tool (MiHpt)

Collective Scale



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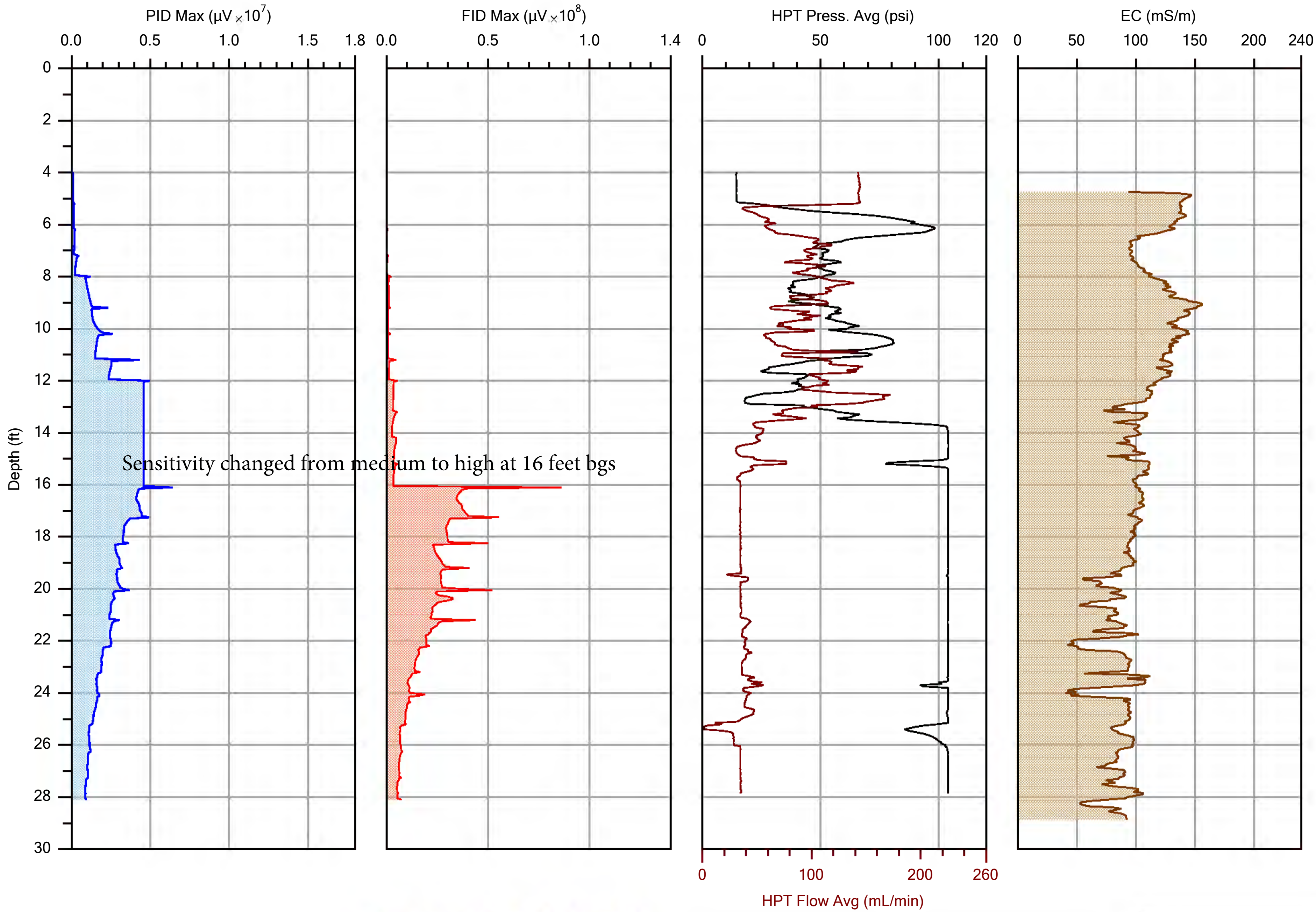

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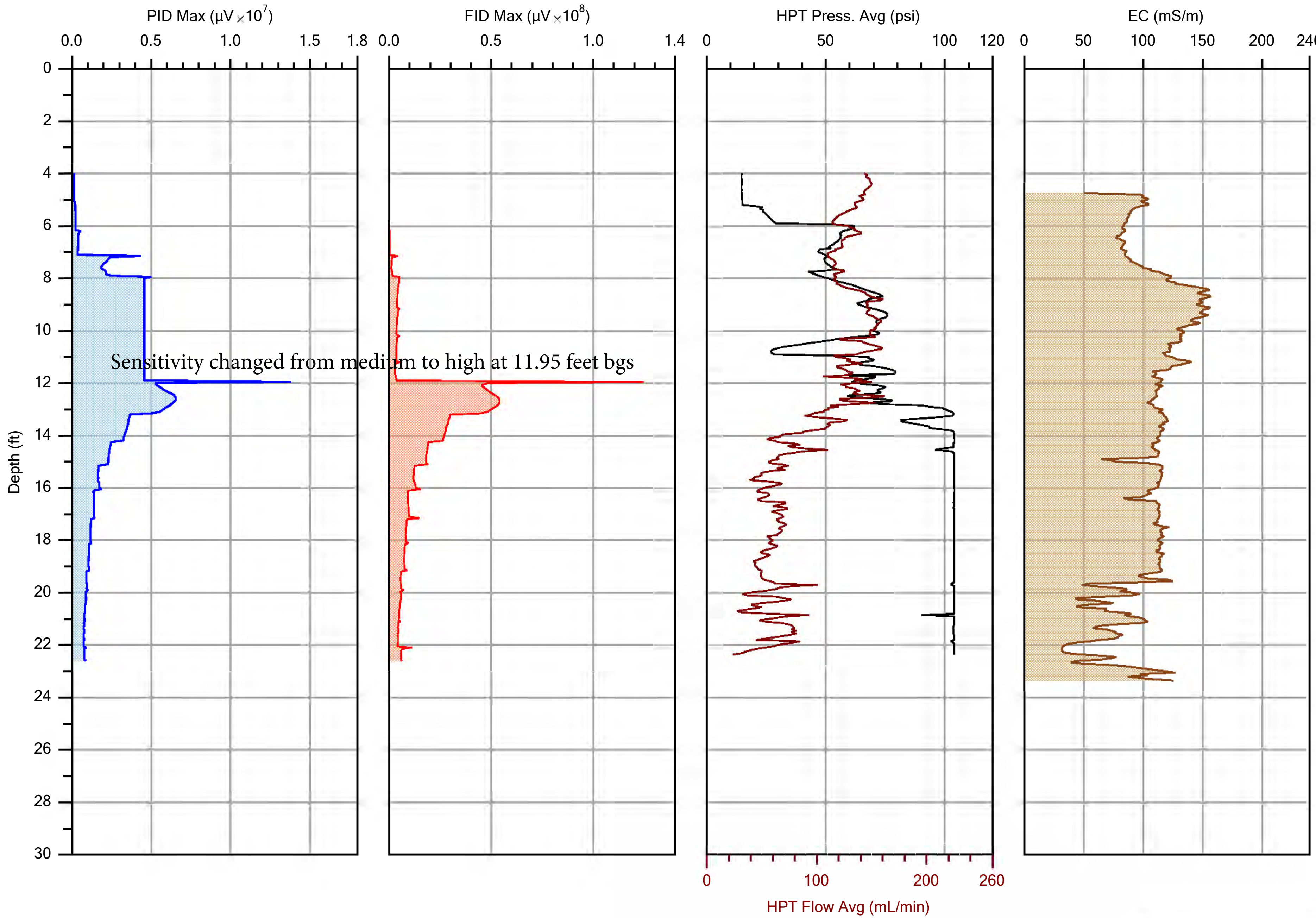
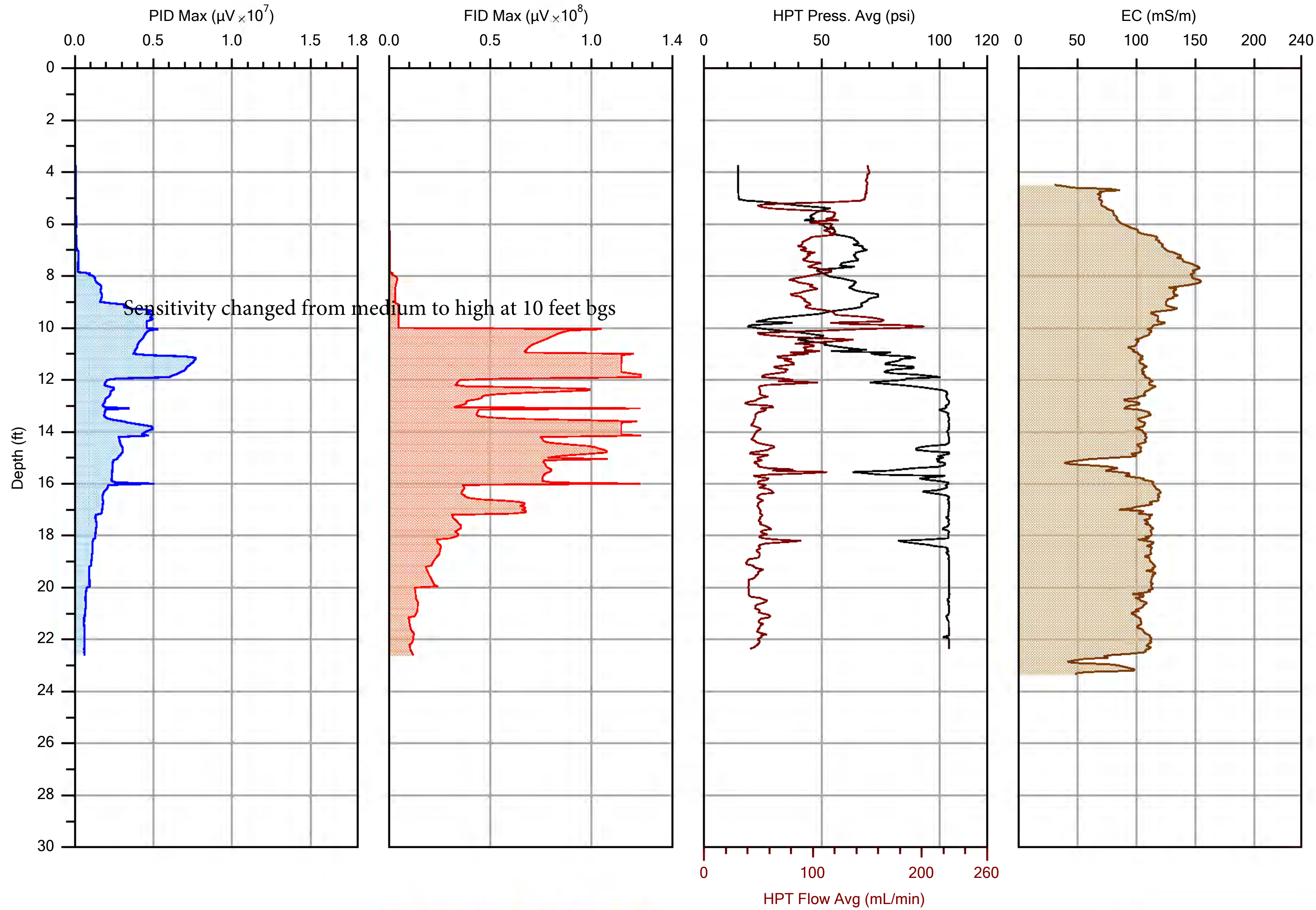
Project ID: Sac & Fox Truck Stop	Client: Terranext LLC	Location: Powhattan, KS

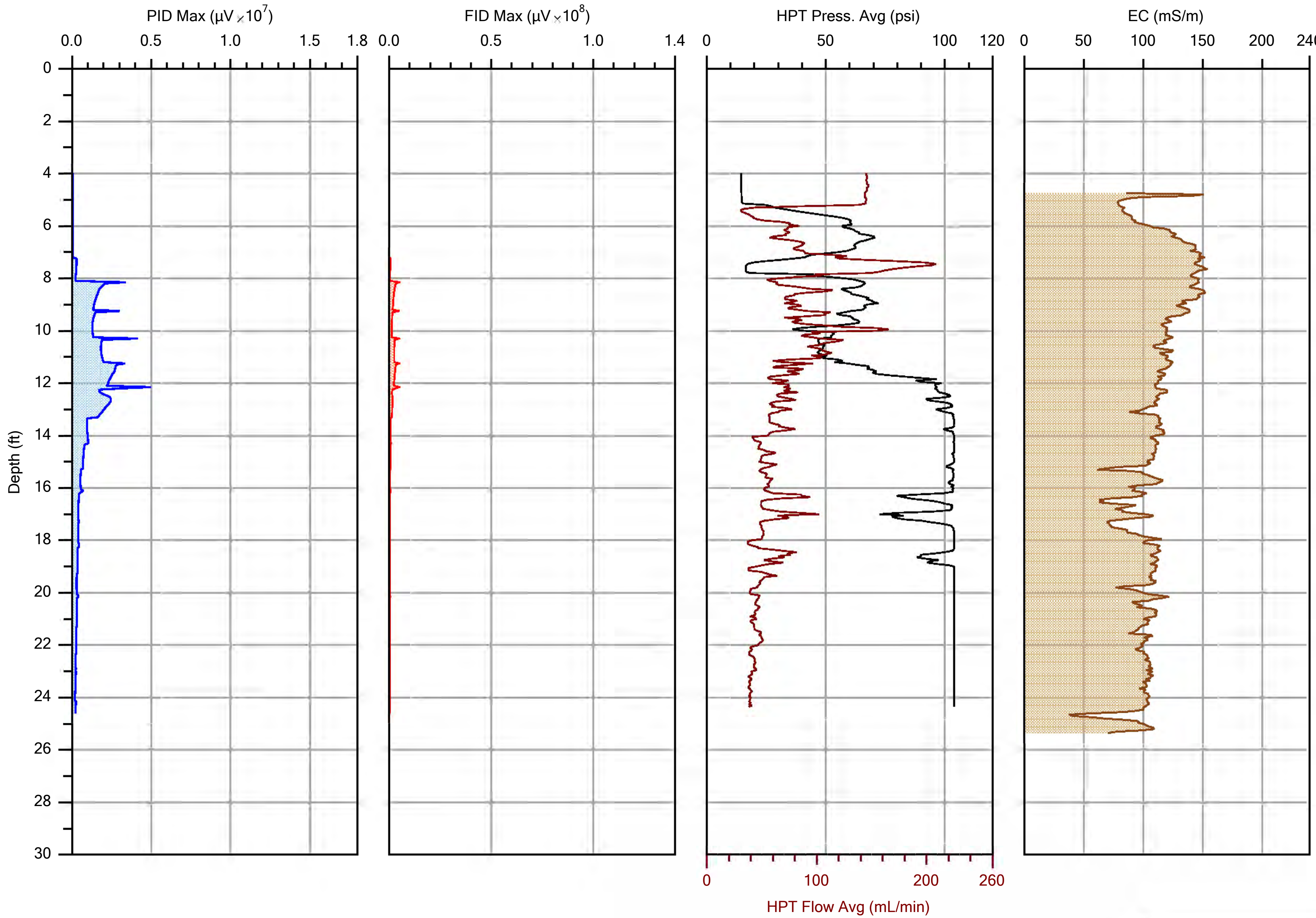


COLUMBIA TECHNOLOGIES

		File: SF08.MHP
Company: COLUMBIA Technologies	Operator: AMS	Date: 3/20/2018
Project ID: Sac & Fox Truck Stop	Client: Terranext LLC	Location: Powhattan, KS

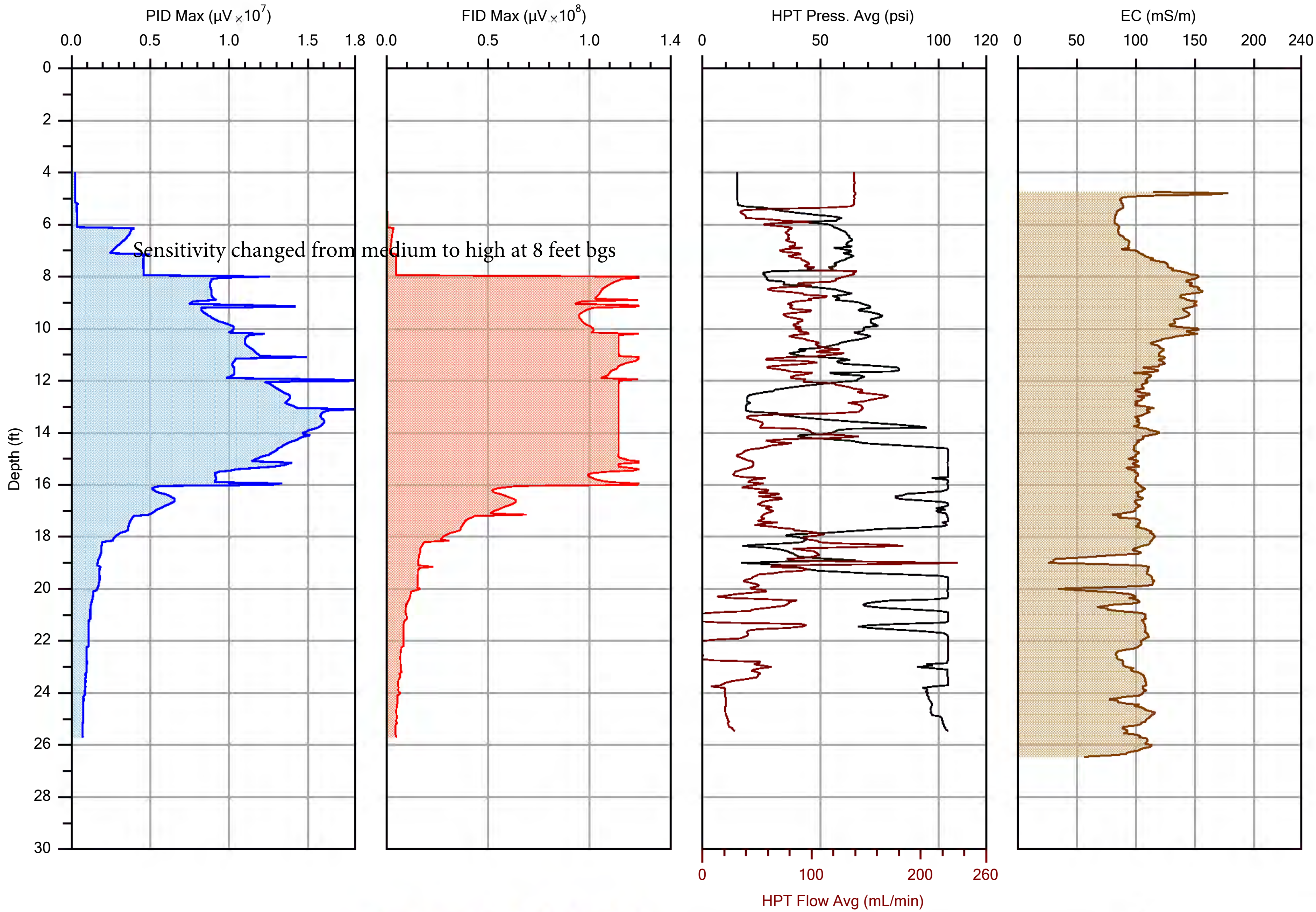


		File: SF09.MHP
Company: COLUMBIA Technologies	Operator: AMS	Date: 3/21/2018
Project ID: Sac & Fox Truck Stop	Client: Terranext LLC	Location: Powhattan, KS



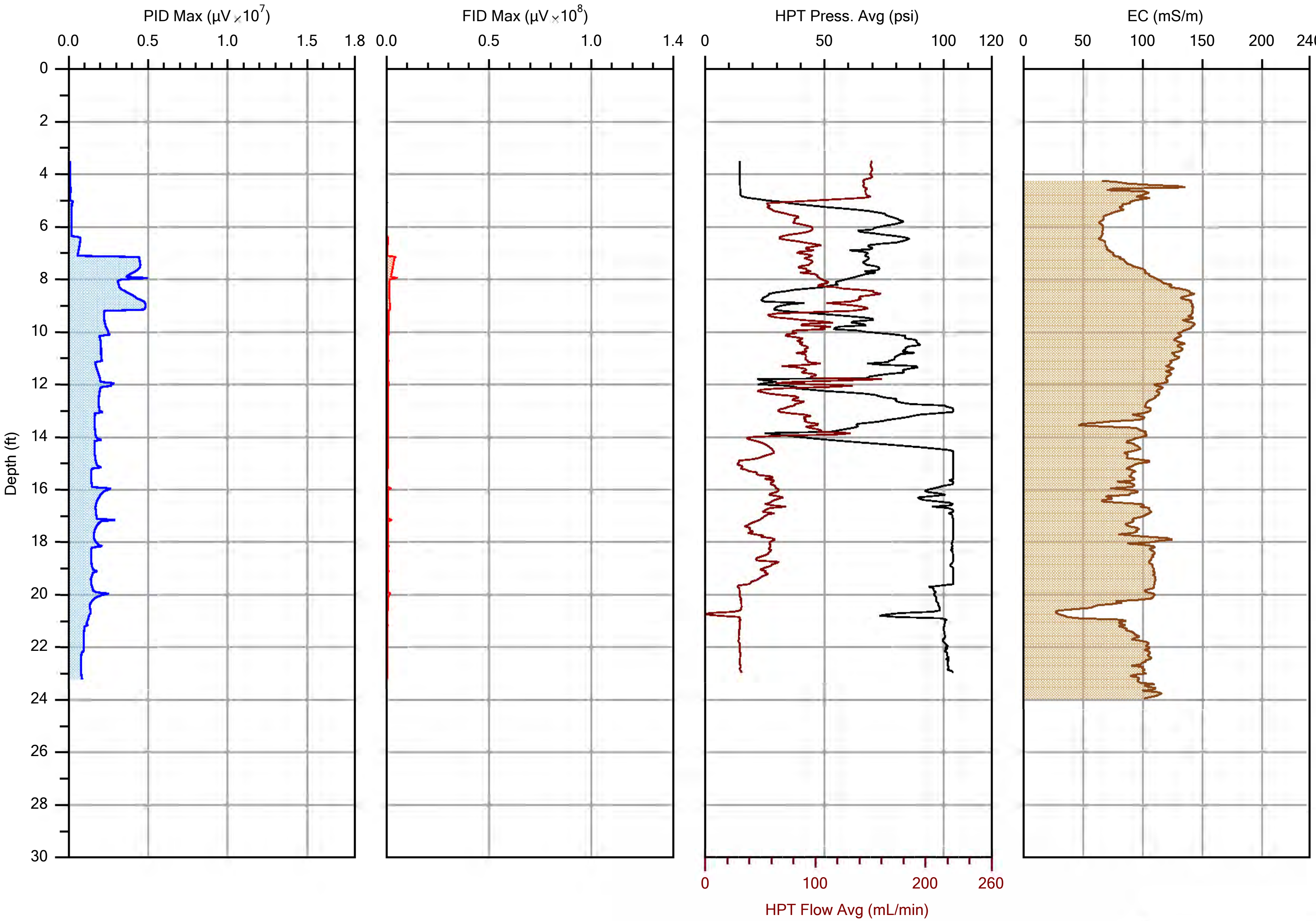
COLUMBIA TECHNOLOGIES

		File: SF10.MHP
Company: COLUMBIA Technologies	Operator: AMS	Date: 3/21/2018
Project ID: Sac & Fox Truck Stop	Client: Terranext LLC	Location: Powhattan, KS



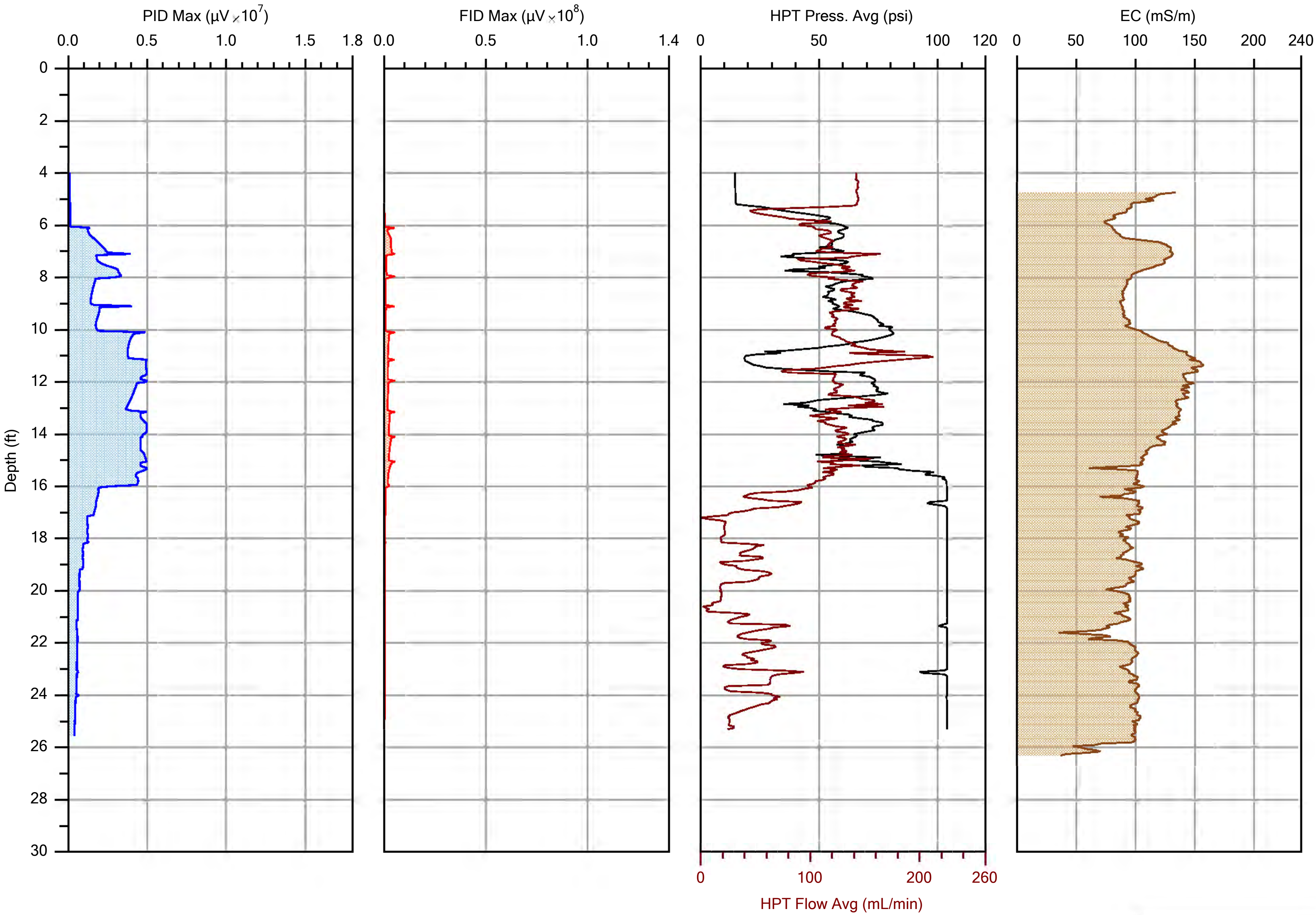
COLUMBIA TECHNOLOGIES

Company: COLUMBIA Technologies	Operator: AMS	File: SF11.MHP Date: 3/20/2018
Project ID: Sac & Fox Truck Stop	Client: Terranext LLC	Location: Powhattan, KS



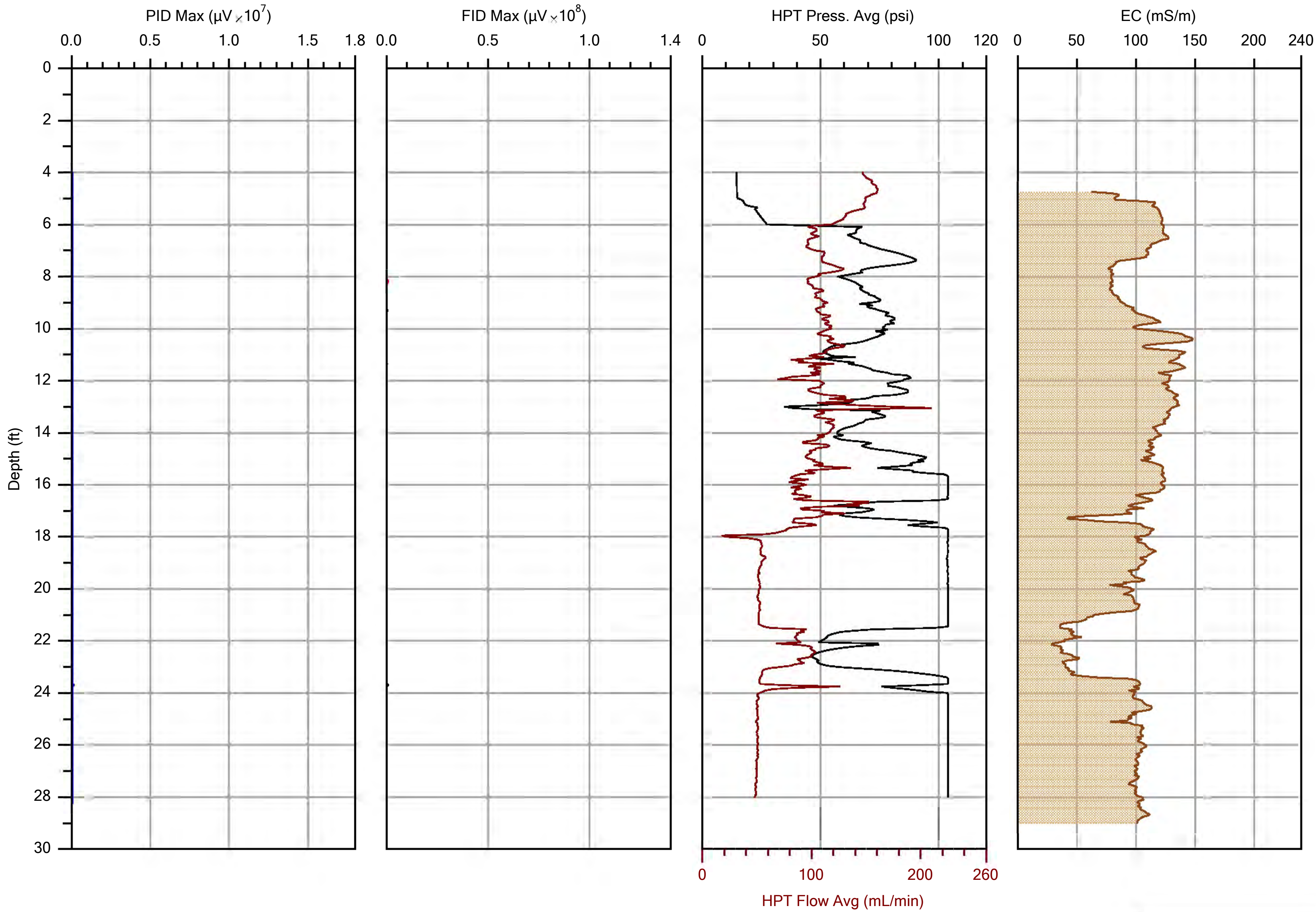
COLUMBIA TECHNOLOGIES

		File: SF12.MHP
Company: COLUMBIA Technologies	Operator: AMS	Date: 3/20/2018
Project ID: Sac & Fox Truck Stop	Client: Terranext LLC	Location: Powhattan, KS



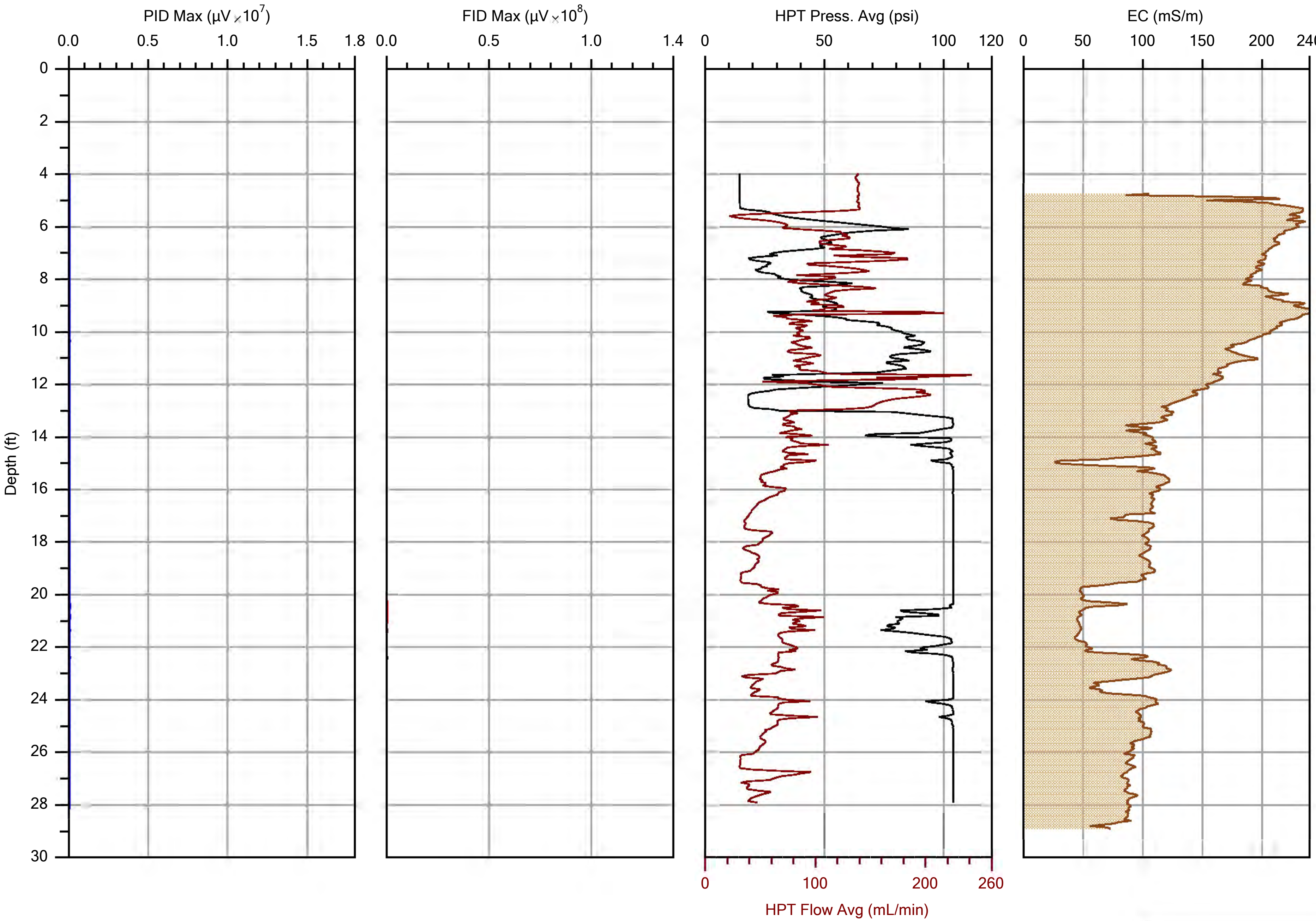
COLUMBIA TECHNOLOGIES

		File: SF16.MHP
Company: COLUMBIA Technologies	Operator: AMS	Date: 3/20/2018
Project ID: Sac & Fox Truck Stop	Client: Terranext LLC	Location: Powhattan, KS



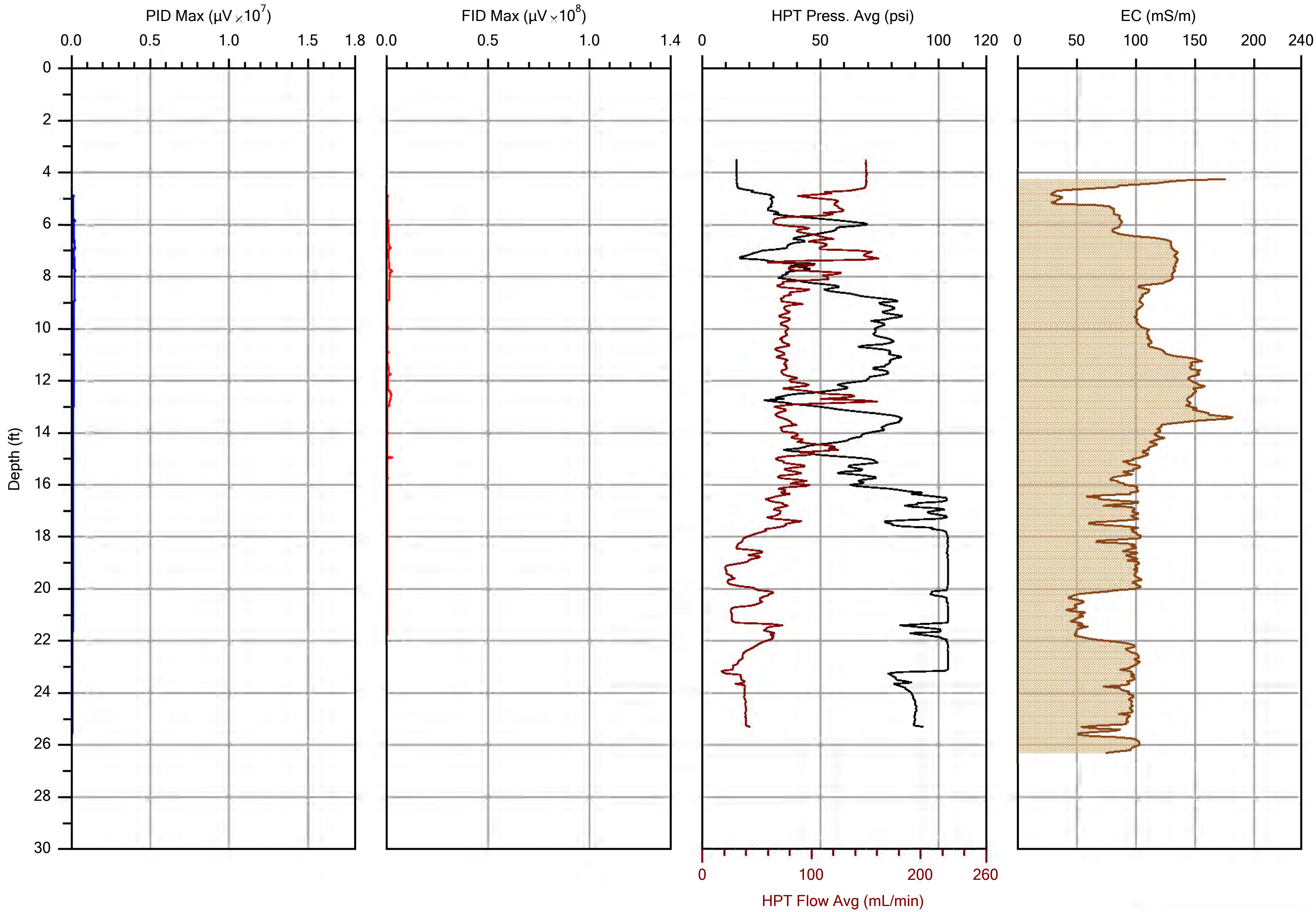
COLUMBIA TECHNOLOGIES

Company: COLUMBIA Technologies	Operator: AMS	File: SF17.MHP Date: 3/21/2018
Project ID: Sac & Fox Truck Stop	Client: Terranext LLC	Location: Powhattan, KS



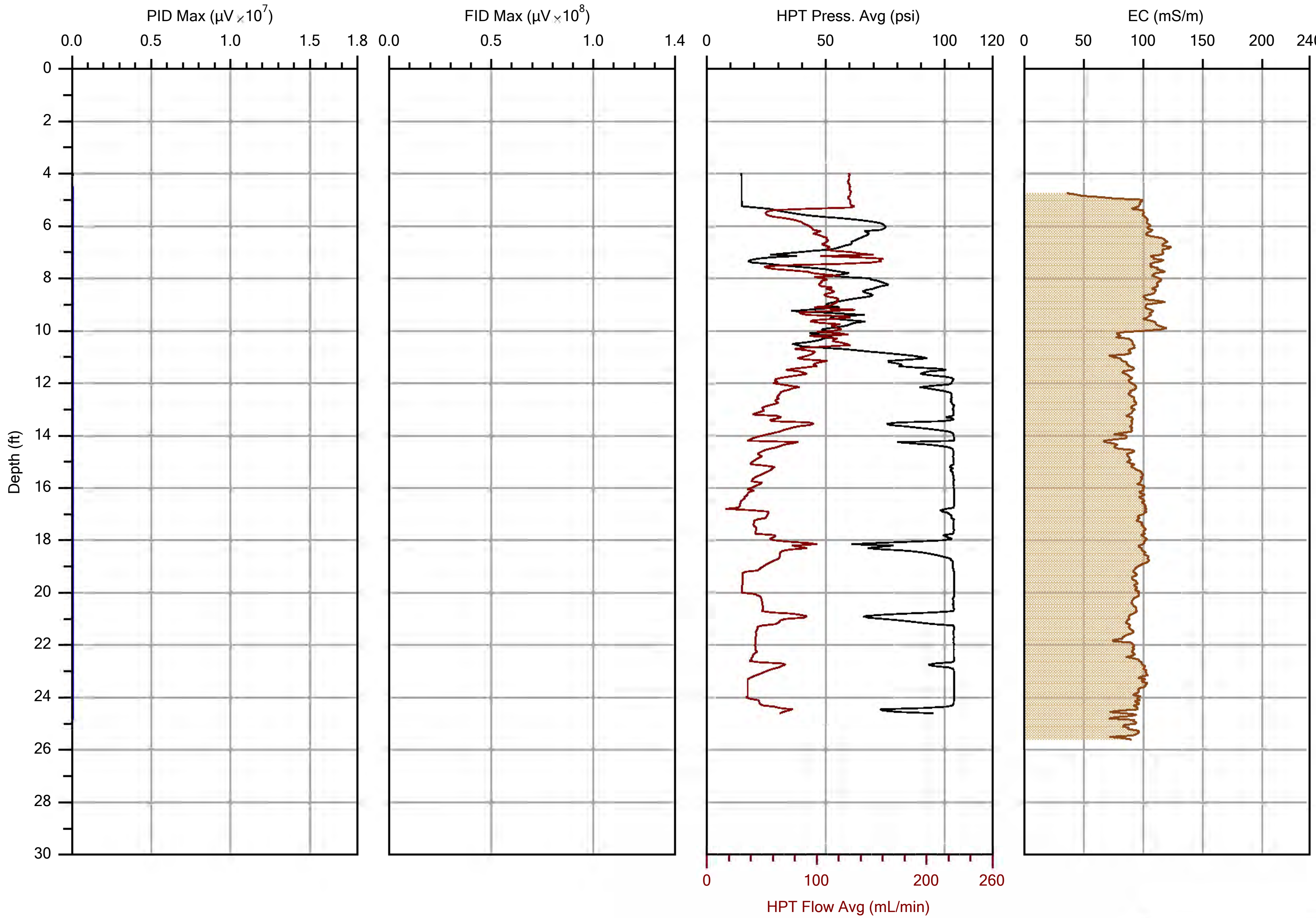
COLUMBIA TECHNOLOGIES

		File: SF18.MHP
Company: COLUMBIA Technologies	Operator: AMS	Date: 3/21/2018
Project ID: Sac & Fox Truck Stop	Client: Terranext LLC	Location: Powhattan, KS



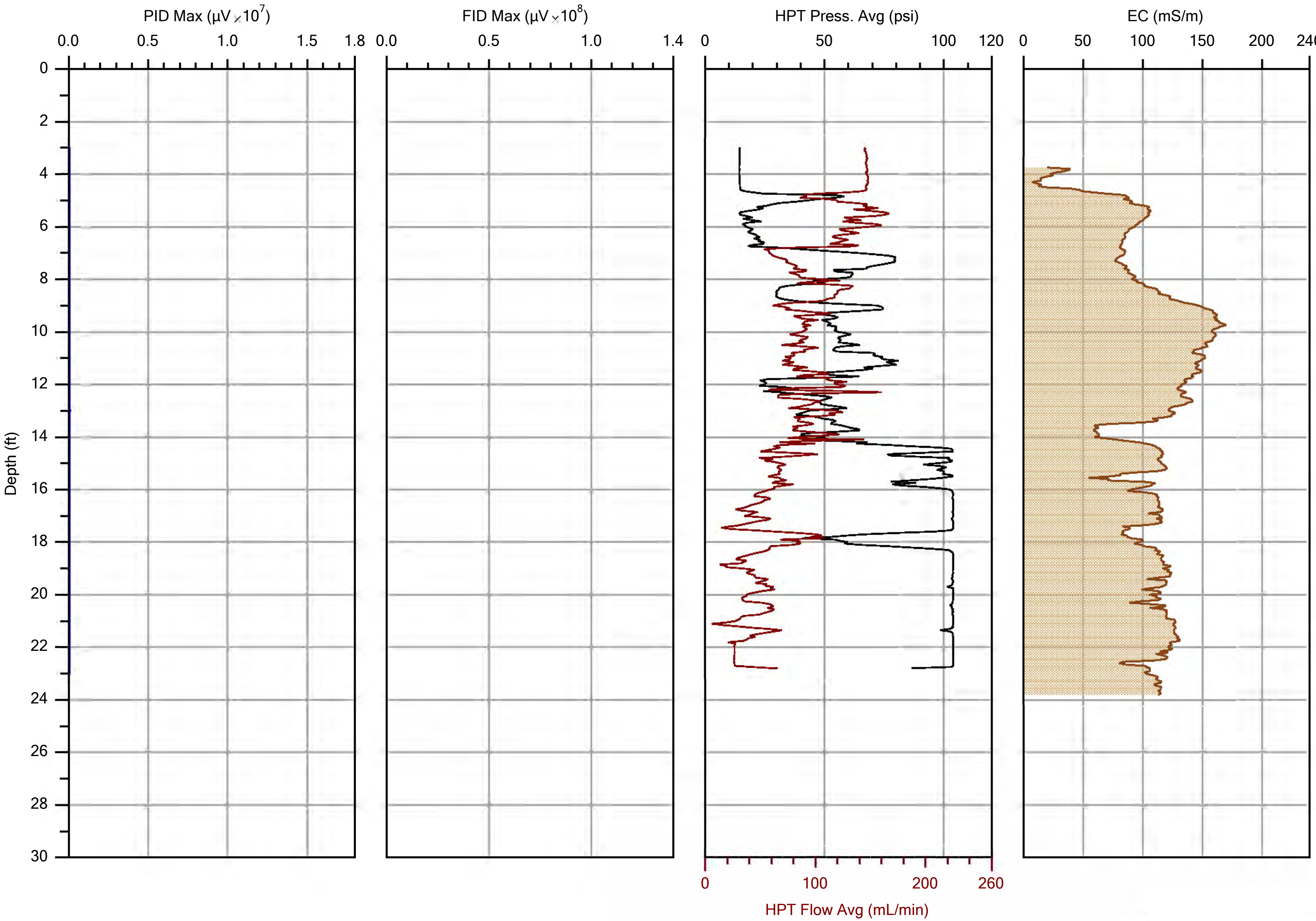
COLUMBIA TECHNOLOGIES

		File: SF19.MHP
Company: COLUMBIA Technologies	Operator: AMS	Date: 3/21/2018
Project ID: Sac & Fox Truck Stop	Client: Terranext LLC	Location: Powhattan, KS



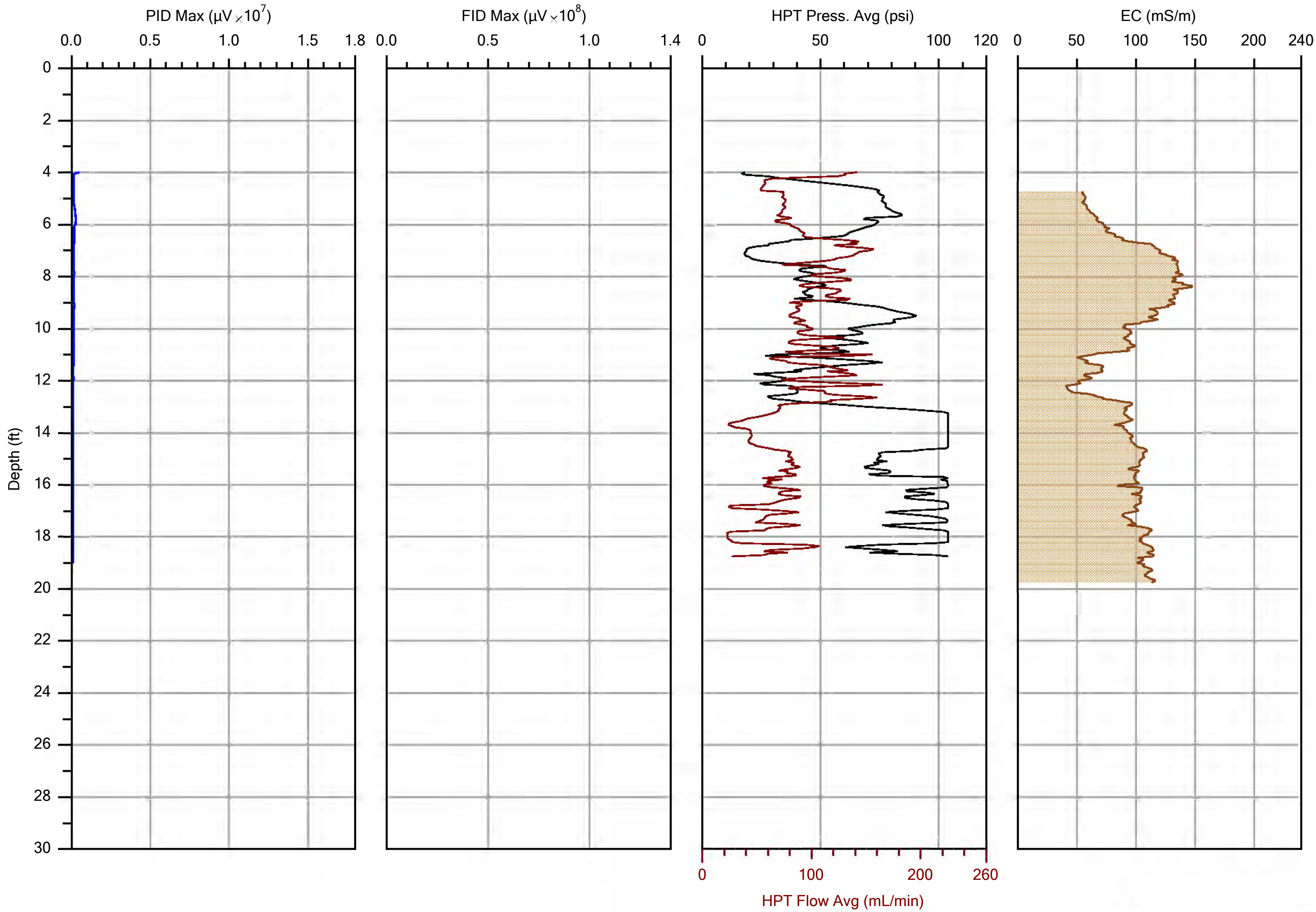
COLUMBIA TECHNOLOGIES

		File: SF20.MHP
Company: COLUMBIA Technologies	Operator: AMS	Date: 3/21/2018
Project ID: Sac & Fox Truck Stop	Client: Terranext LLC	Location: Powhattan, KS



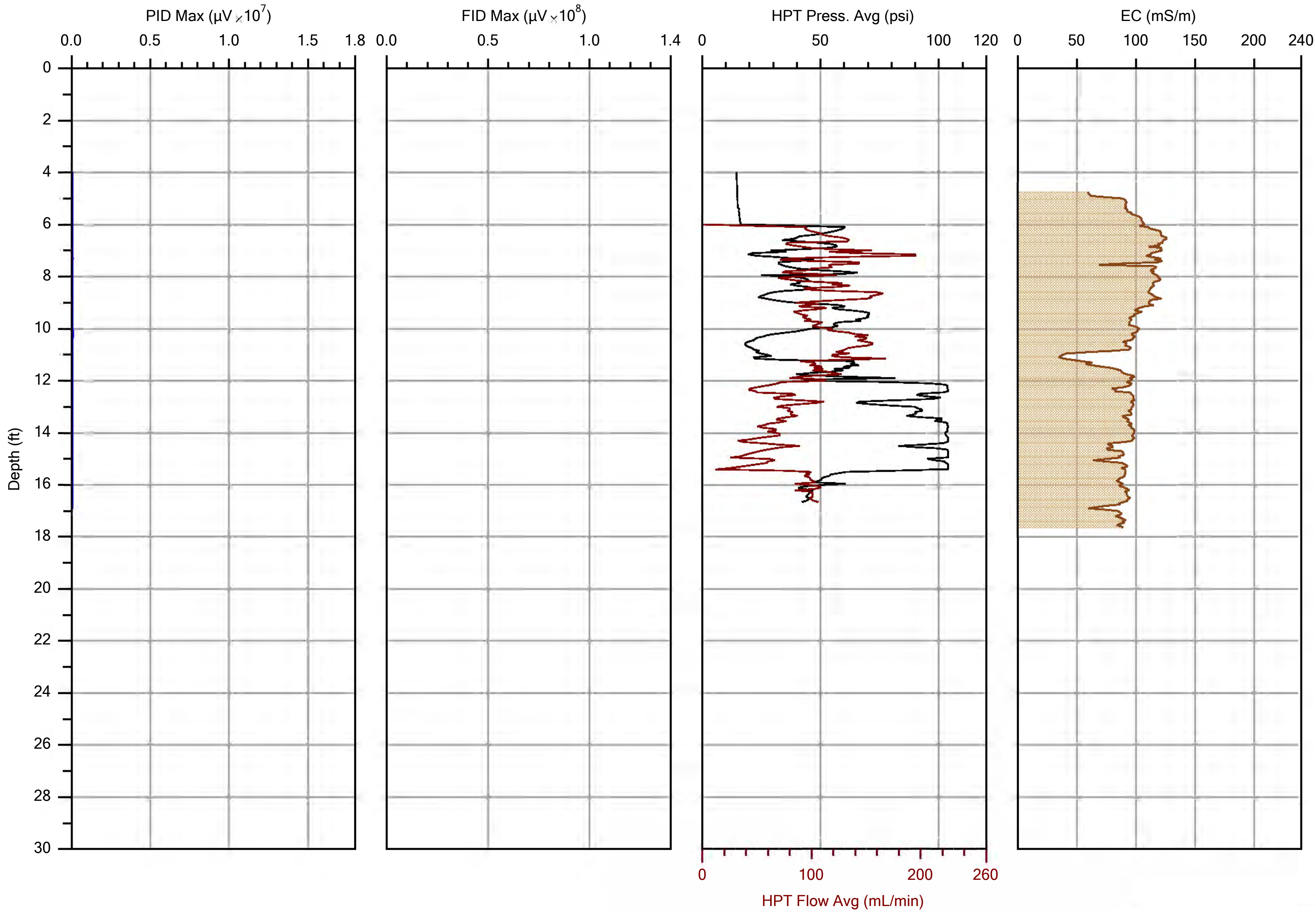
COLUMBIA TECHNOLOGIES

		File: SF21.MHP
Company: COLUMBIA Technologies	Operator: AMS	Date: 3/22/2018
Project ID: Sac & Fox Truck Stop	Client: Terranext LLC	Location: Powhattan, KS



COLUMBIA TECHNOLOGIES

		File: SF22.MHP
Company: COLUMBIA Technologies	Operator: AMS	Date: 3/22/2018
Project ID: Sac & Fox Truck Stop	Client: Terranext LLC	Location: Powhattan, KS

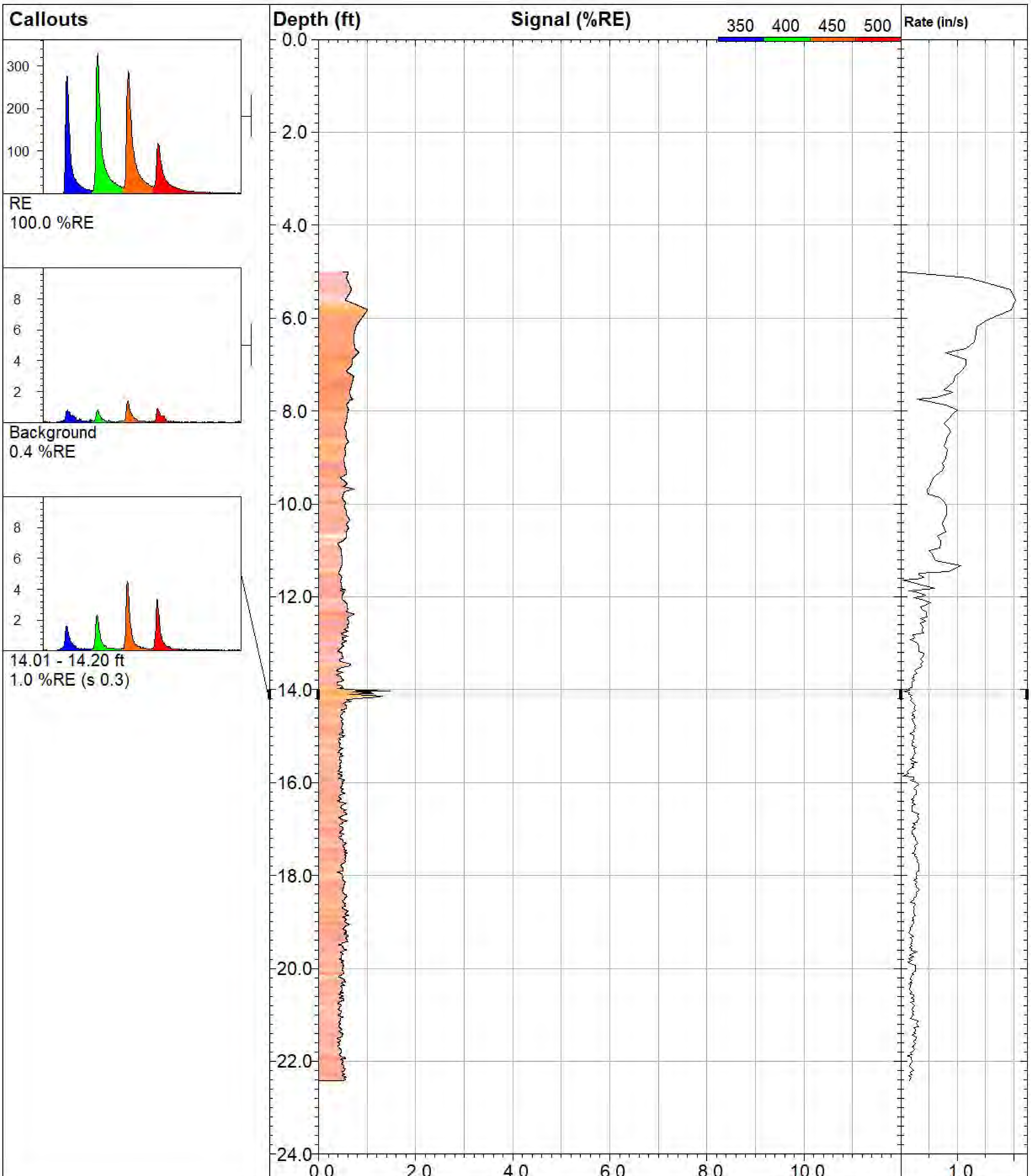


COLUMBIA TECHNOLOGIES

		File: SF23.MHP
Company: COLUMBIA Technologies	Operator: AMS	Date: 3/22/2018
Project ID: Sac & Fox Truck Stop	Client: Terranext LLC	Location: Powhattan, KS

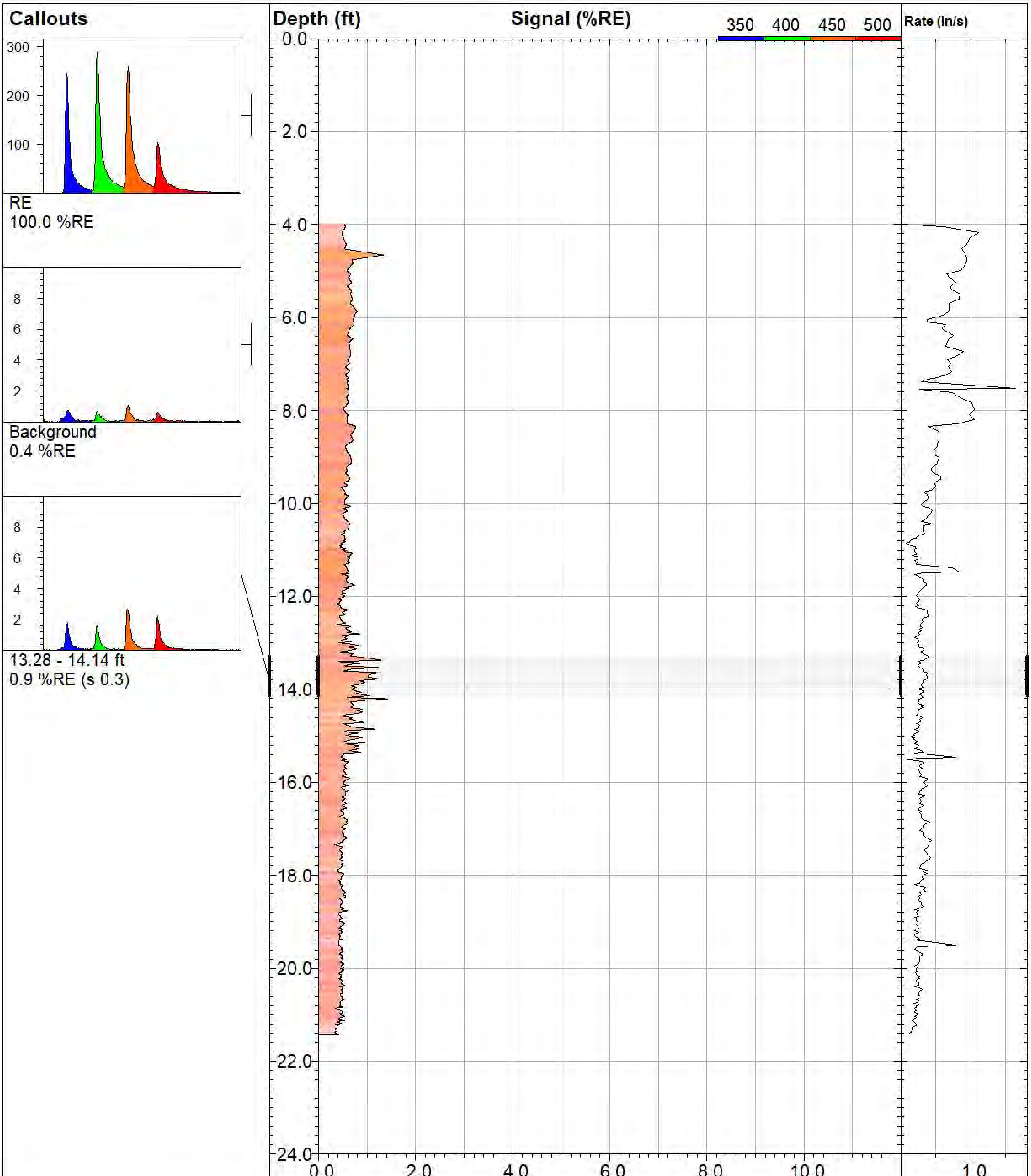
APPENDIX F – LIF/UVOST® Logs

Collective Scale



SF01		UVOST® By Dakota www.DakotaTechnologies.com
Site: **Sac & Fox Truck Stop**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **22.41 ft**
Client / Job: **James Cawley /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **1.5 %RE @ 14.02 ft**
Operator / Unit: **AMS / UVOST1005**	*Elevation:* **Unavailable**	*Date & Time:* **2018-03-19 11:52 EDT**

COLUMBIA TECHNOLOGIES

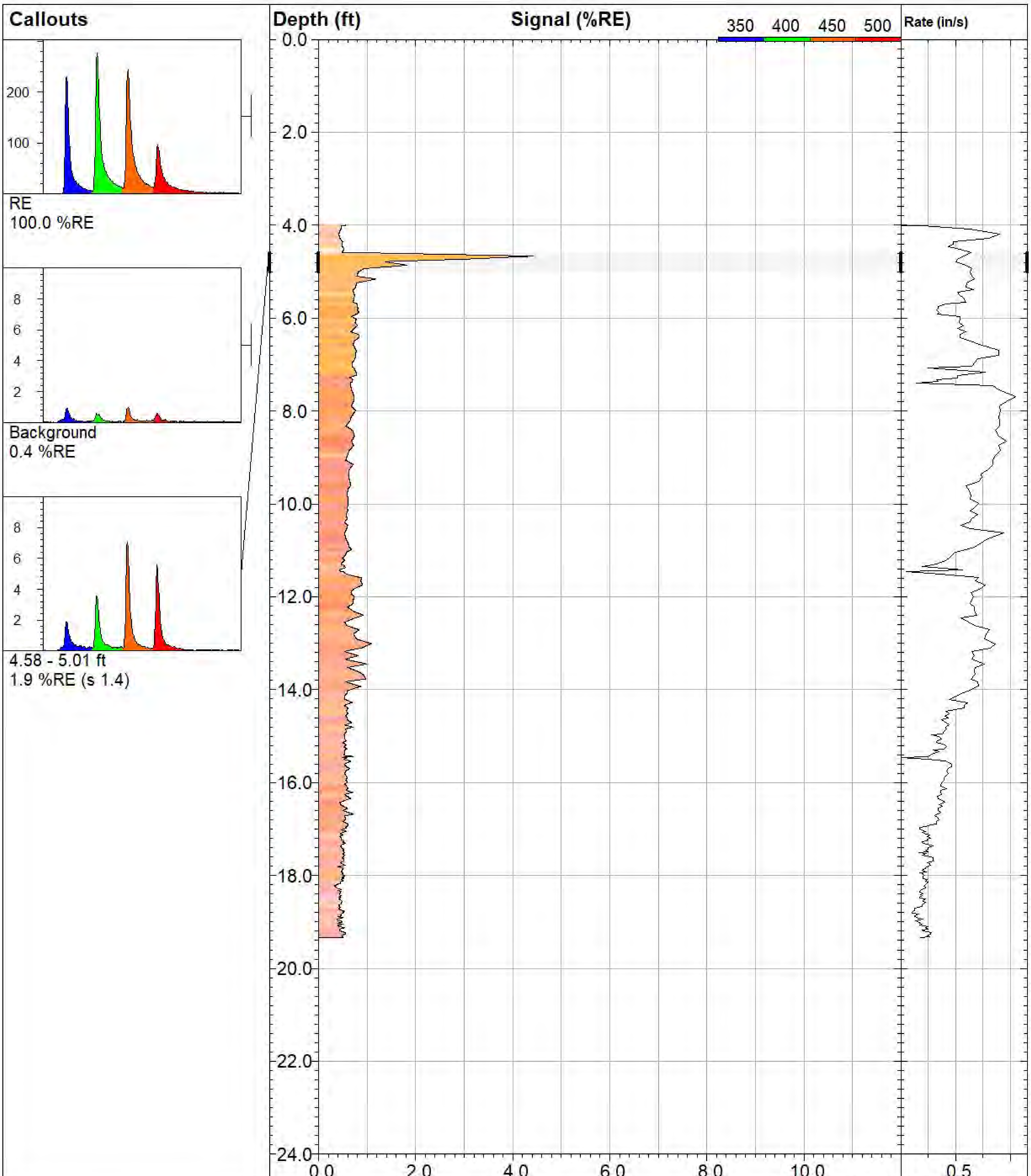


SF02

UVOST® By Dakota
www.DakotaTechnologies.com

COLUMBIA TECHNOLOGIES

Site: **Sac & Fox Truck Stop**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **21.42 ft**
Client / Job: **James Cawley /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **1.4 %RE @ 14.20 ft**
Operator / Unit: **AMS / UVOST1005**	*Elevation:* **Unavailable**	*Date & Time:* **2018-03-19 13:09 EDT**

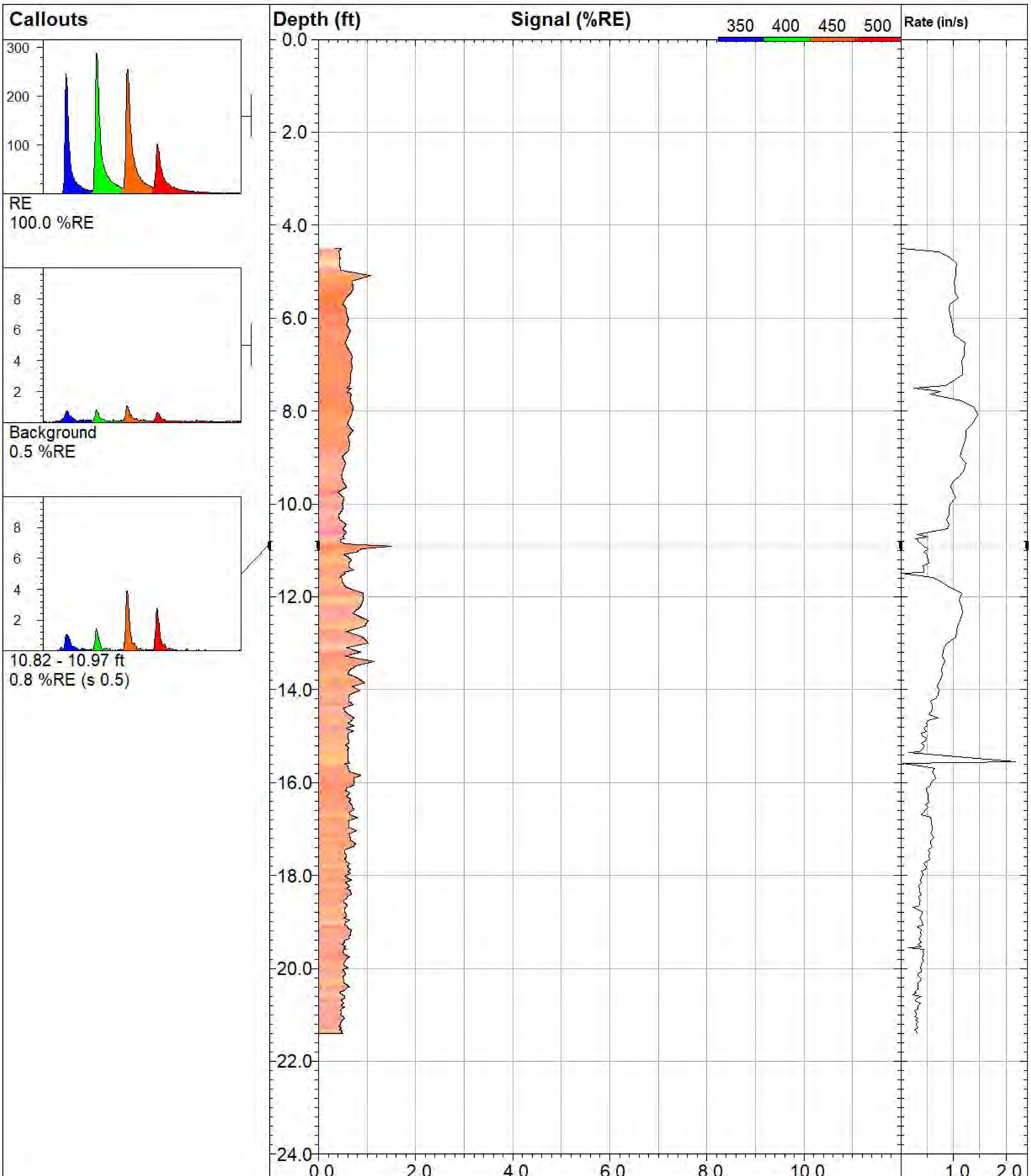


COLUMBIA TECHNOLOGIES

SF03

UVOST® By Dakota
www.DakotaTechnologies.com

Site: **Sac & Fox Truck Stop**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **19.34 ft**
Client / Job: **James Cawley /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **4.5 %RE @ 4.67 ft**
Operator / Unit: **AMS / UVOST1005**	*Elevation:* **Unavailable**	*Date & Time:* **2018-03-19 14:37 EDT**

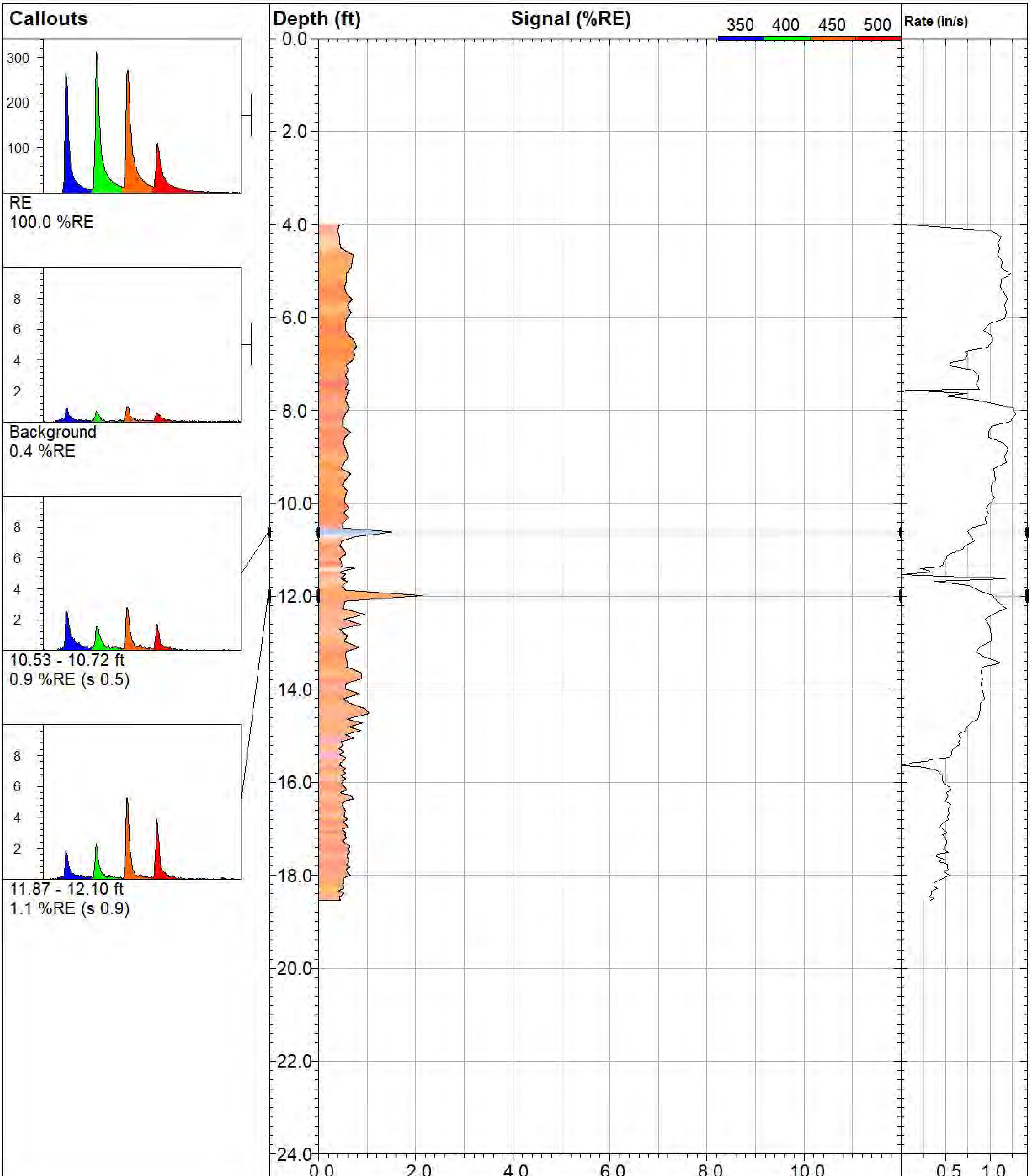


SF04

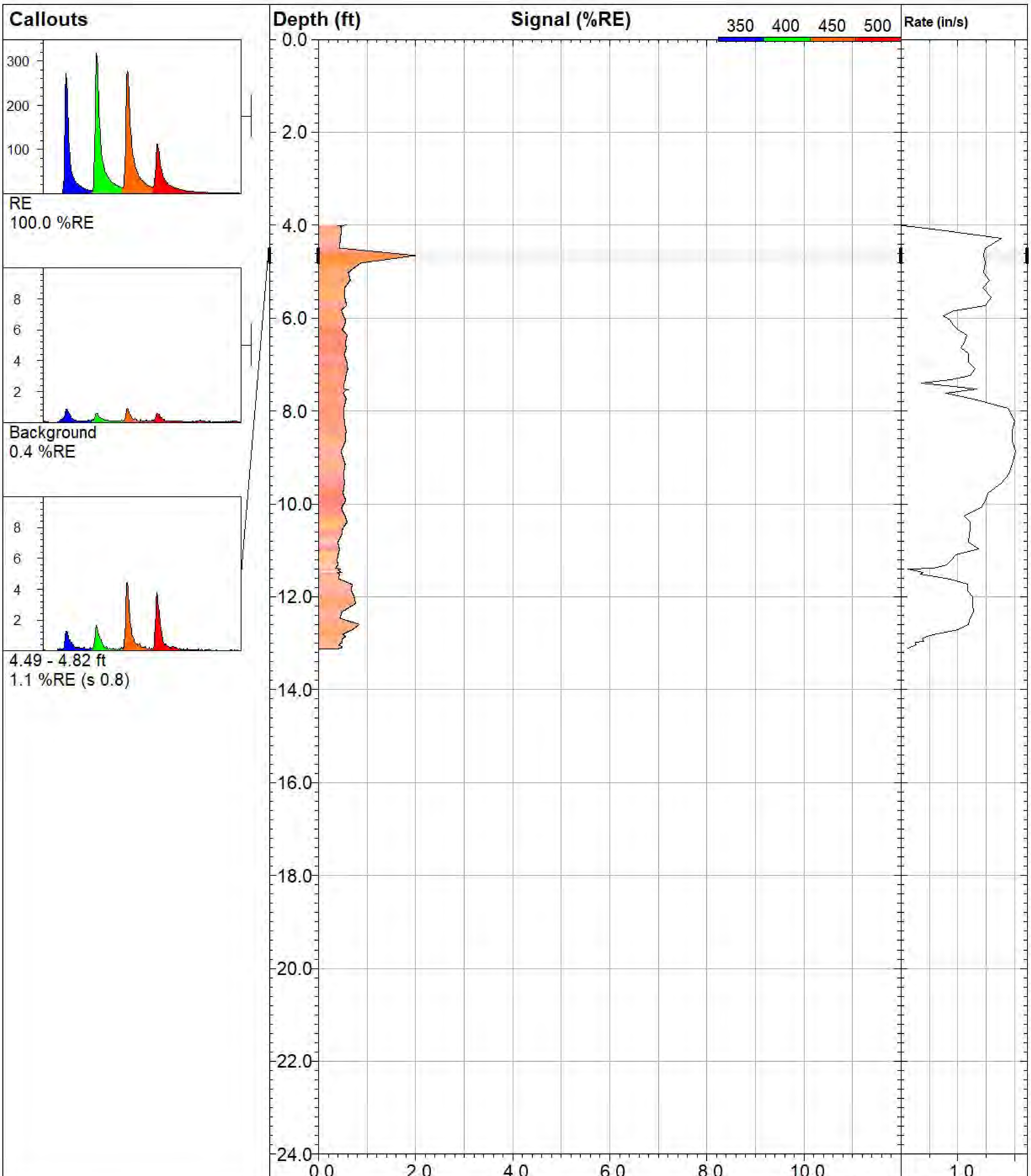
UVOST® By Dakota
www.DakotaTechnologies.com

COLUMBIA TECHNOLOGIES

Site: **Sac & Fox Truck Stop**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **21.40 ft**
Client / Job: **James Cawley /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **1.5 %RE @ 10.91 ft**
Operator / Unit: **AMS / UVOST1005**	*Elevation:* **Unavailable**	*Date & Time:* **2018-03-19 18:38 EDT**

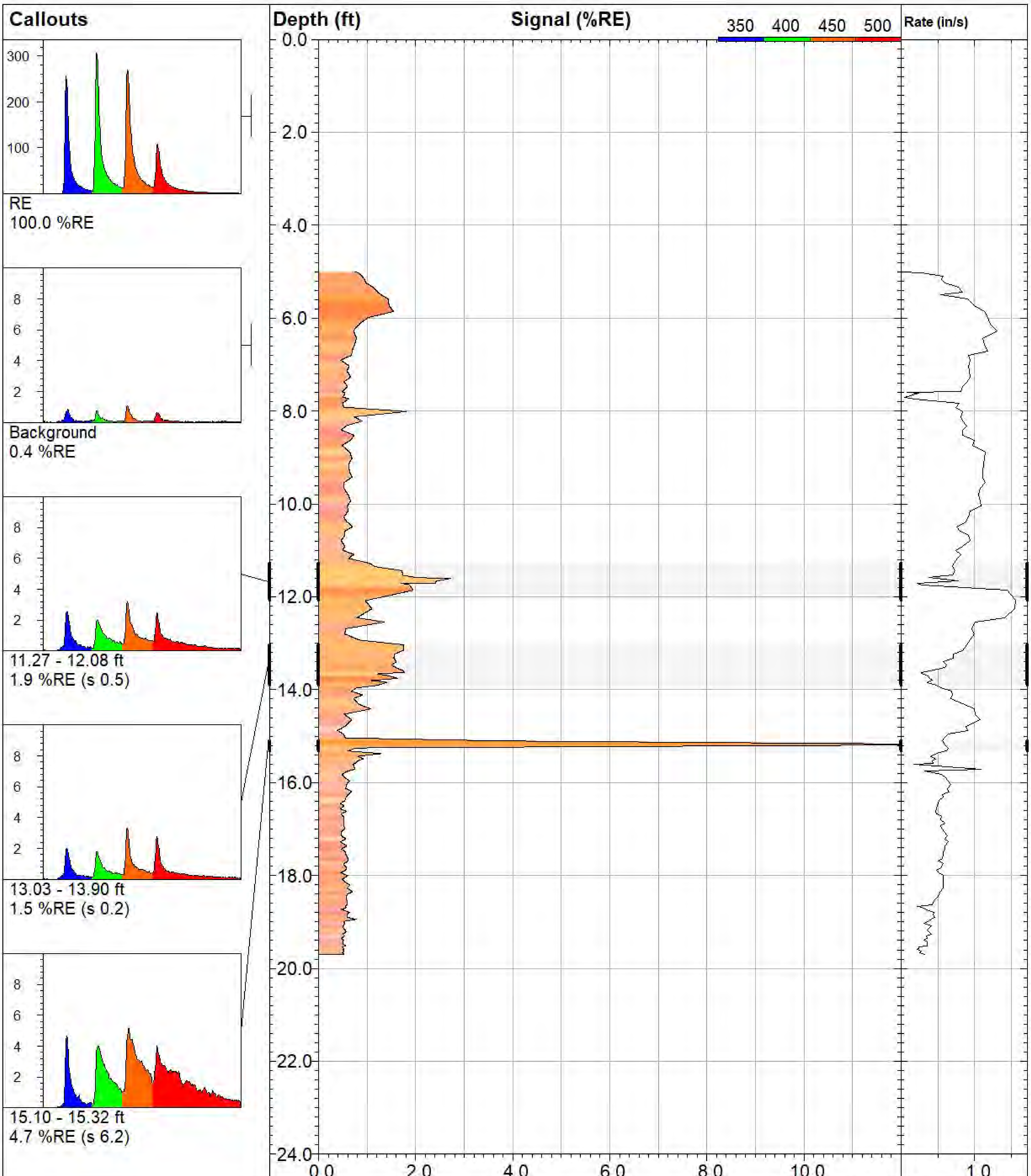


SF06		UVOST® By Dakota www.DakotaTechnologies.com
Site: **Sac & Fox Truck Stop**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **18.54 ft**
Client / Job: **James Cawley /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **2.1 %RE @ 11.98 ft**
Operator / Unit: **AMS / UVOST1005**	*Elevation:* **Unavailable**	*Date & Time:* **2018-03-19 19:29 EDT**



COLUMBIA TECHNOLOGIES

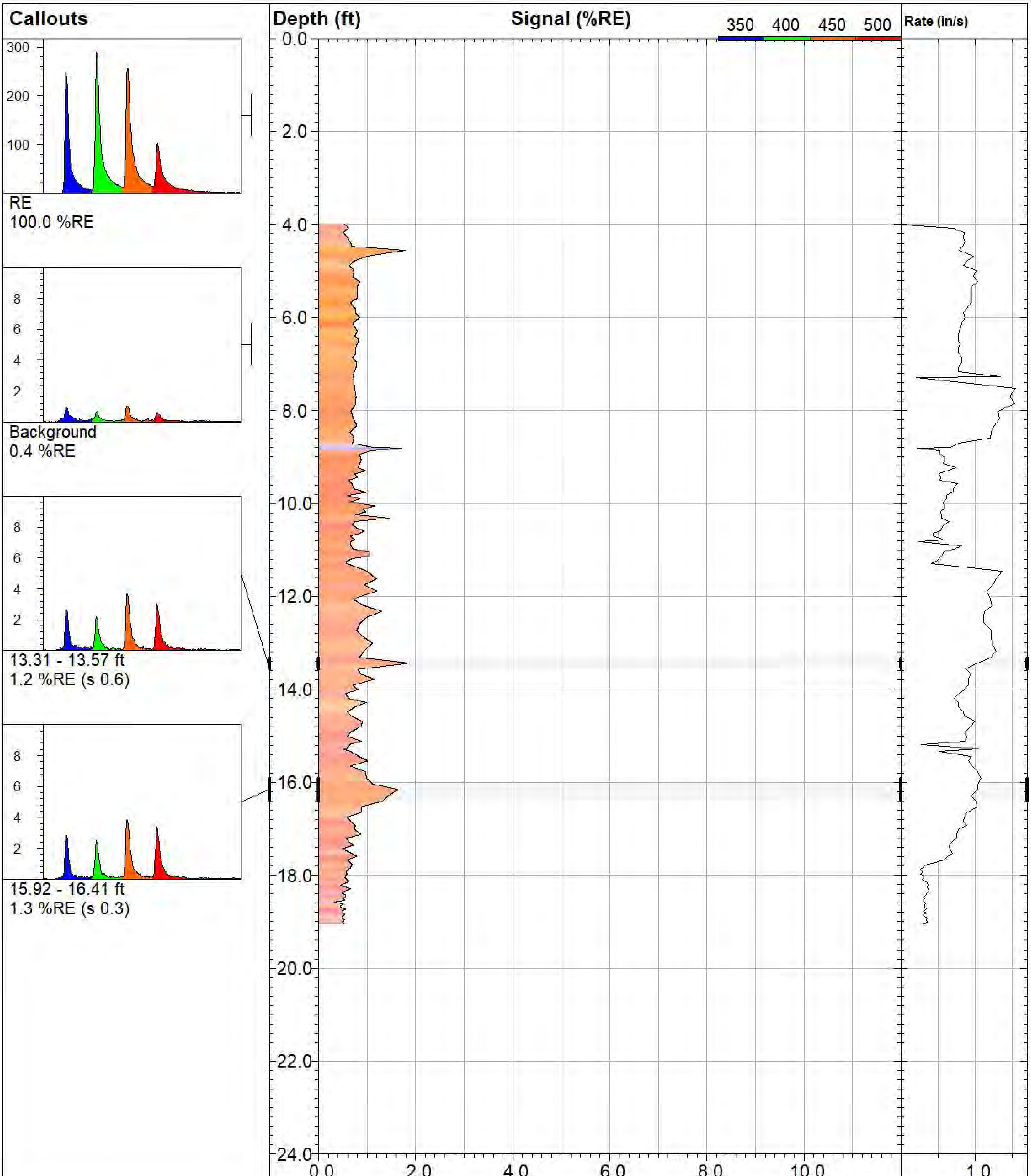
SF13		UVOST® By Dakota www.DakotaTechnologies.com
Site: **Sac & Fox Truck Stop**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **13.12 ft**
Client / Job: **James Cawley /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **2.0 %RE @ 4.65 ft**
Operator / Unit: **AMS / UVOST1005**	*Elevation:* **Unavailable**	*Date & Time:* **2018-03-19 17:21 EDT**



SF14

UVOST® By Dakota
www.DakotaTechnologies.com

Site:	Y Coord.(Lat-N) / System:	Final depth:
Sac & Fox Truck Stop	**Unavailable / NA**	**19.70 ft**
Client / Job:	*X Coord.(Lng-E) / Fix:*	*Max signal:*
James Cawley /	**Unavailable / NA**	**13.7 %RE @ 15.18 ft**
Operator / Unit:	*Elevation:*	*Date & Time:*
AMS / UVOST1005	**Unavailable**	**2018-03-19 15:23 EDT**

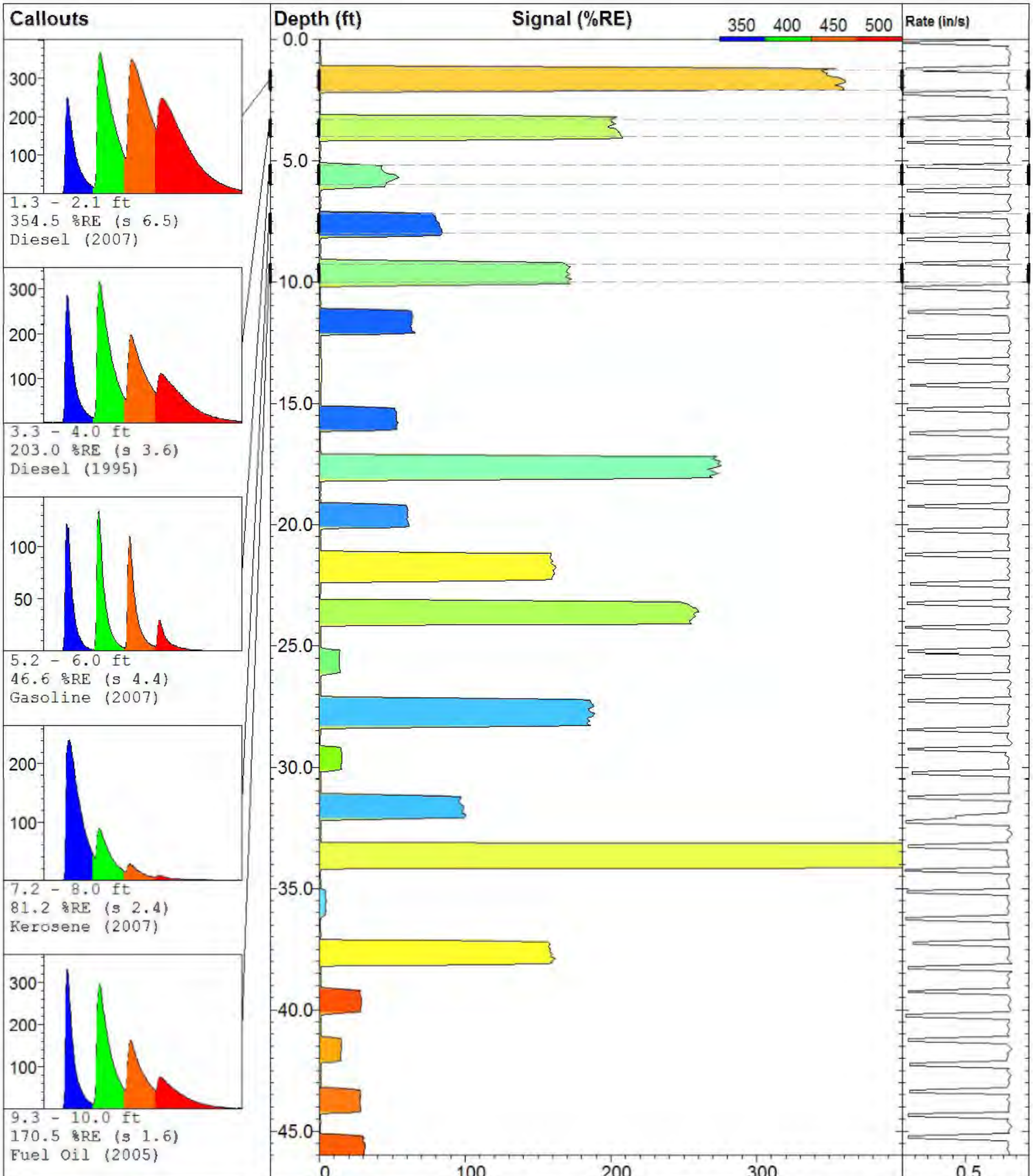


SF15

UVOST® By Dakota
www.DakotaTechnologies.com

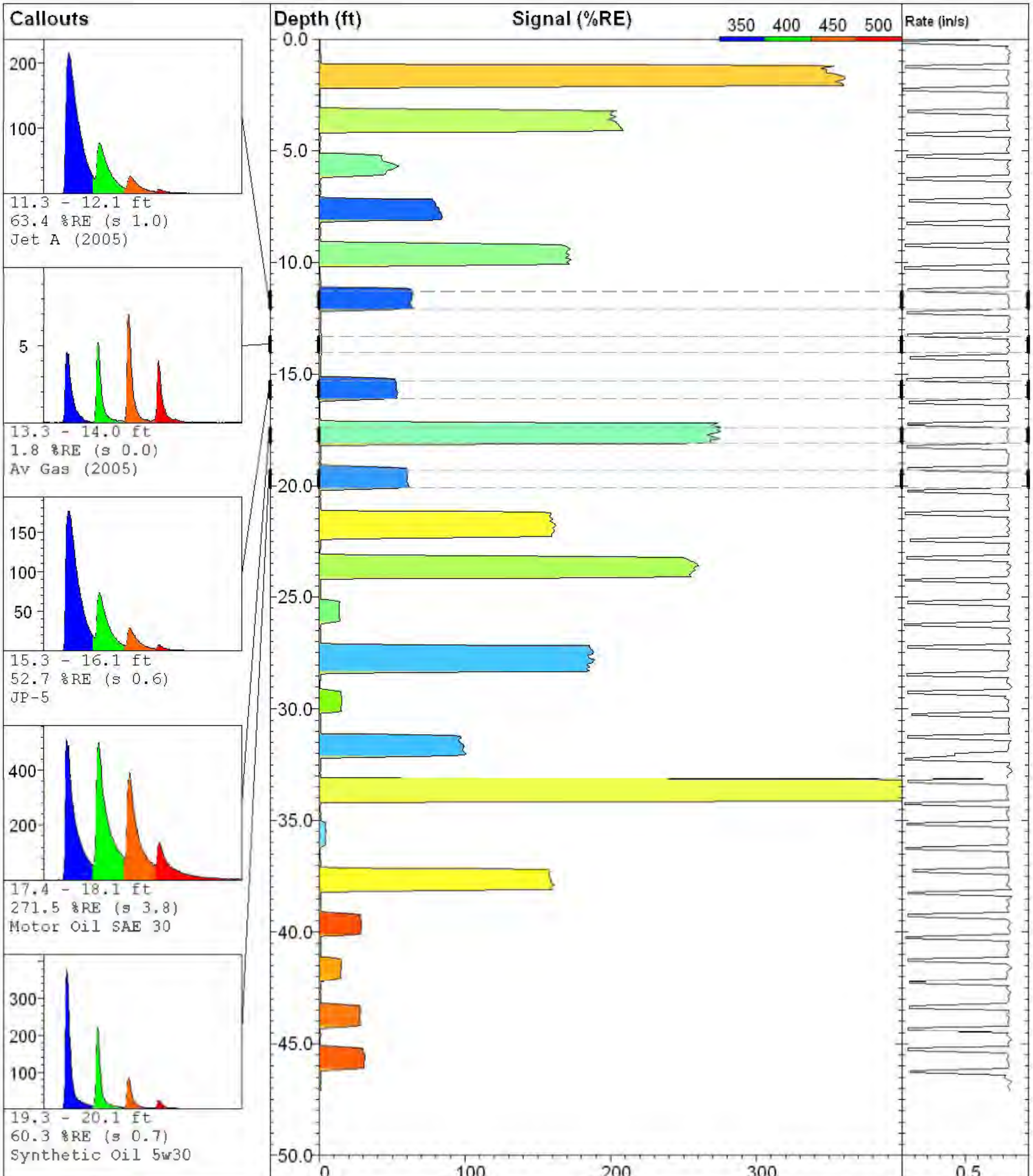
Site: **Sac & Fox Truck Stop**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **19.04 ft**
Client / Job: **James Cawley /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **1.9 %RE @ 13.43 ft**
Operator / Unit: **AMS / UVOST1005**	*Elevation:* **Unavailable**	*Date & Time:* **2018-03-19 16:28 EDT**

APPENDIX G – UVOST® Response to Various Saturated Products on Wet Sand



Dakota Technologies, Inc.
Fargo, ND (701)237-4908
www.DakotaTechnologies.com

Various products on sand		UVOST By Dakota www.DakotaTechnologies.com
Site: **Examples**	*Latitude / Datum:* **Unavailable / NA**	*Final depth:* **47.10 ft**
Client: **DTI**	*Longitude / Fix:* **Unavailable / NA**	*Max signal:* **826.6 % @ 33.20 ft**
Job:	*Operator/Unit:* **T.Rudolph/UVOST1002**	*Date & Time:* **2007-08-24 14:25 CDT**

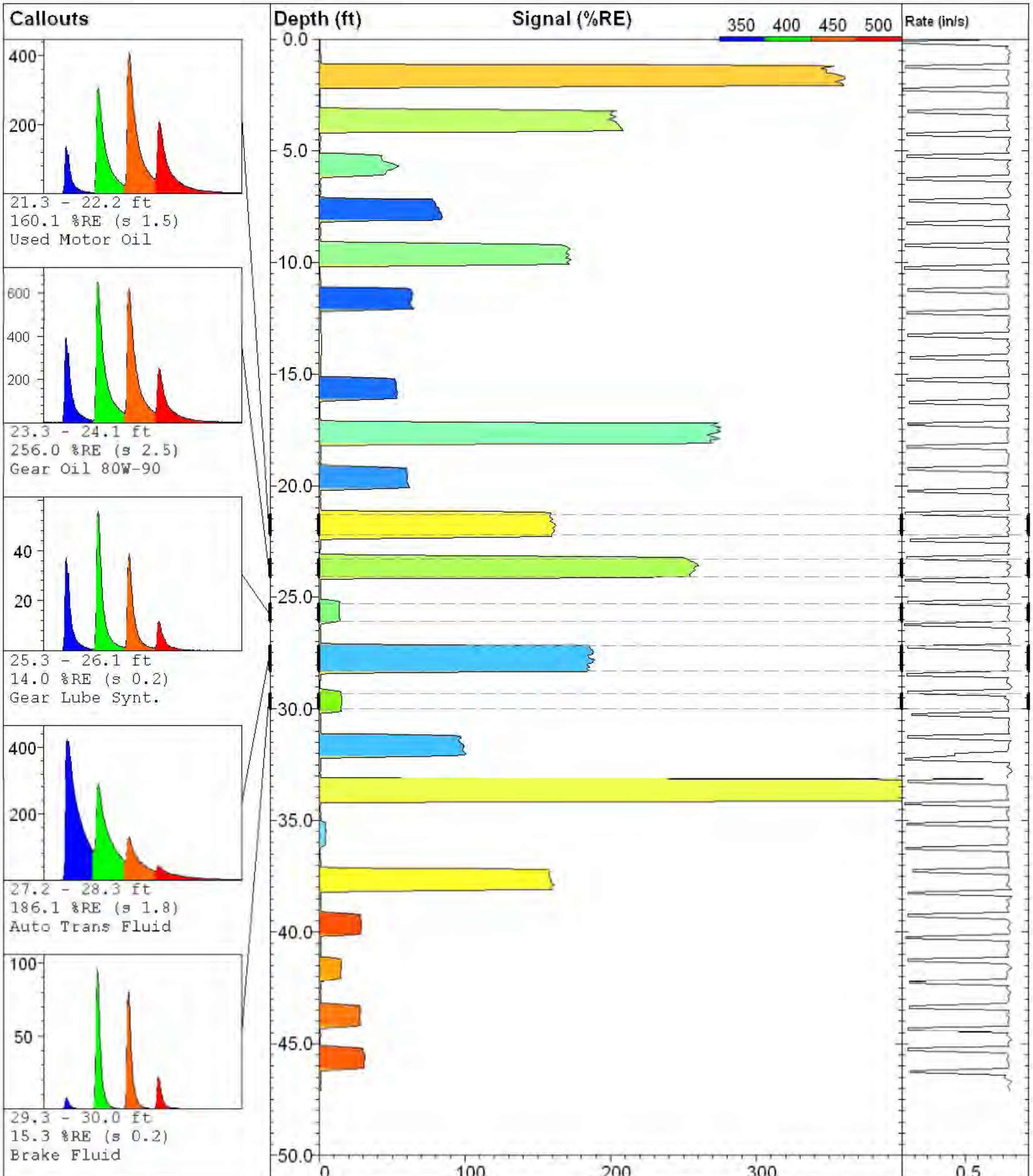


Various products on sand

UVOST By Dakota
www.DakotaTechnologies.com

Site: **Examples**	*Latitude / Datum:* **Unavailable / NA**	*Final depth:* **47.10 ft**
Client: **DTI**	*Longitude / Fix:* **Unavailable / NA**	*Max signal:* **826.6 % @ 33.20 ft**
Job:	*Operator/Unit:* **T.Rudolph/UVOST1002**	*Date & Time:* **2007-08-24 14:25 CDT**

Dakota Technologies, Inc.
Fargo, ND (701)237-4908
www.DakotaTechnologies.com

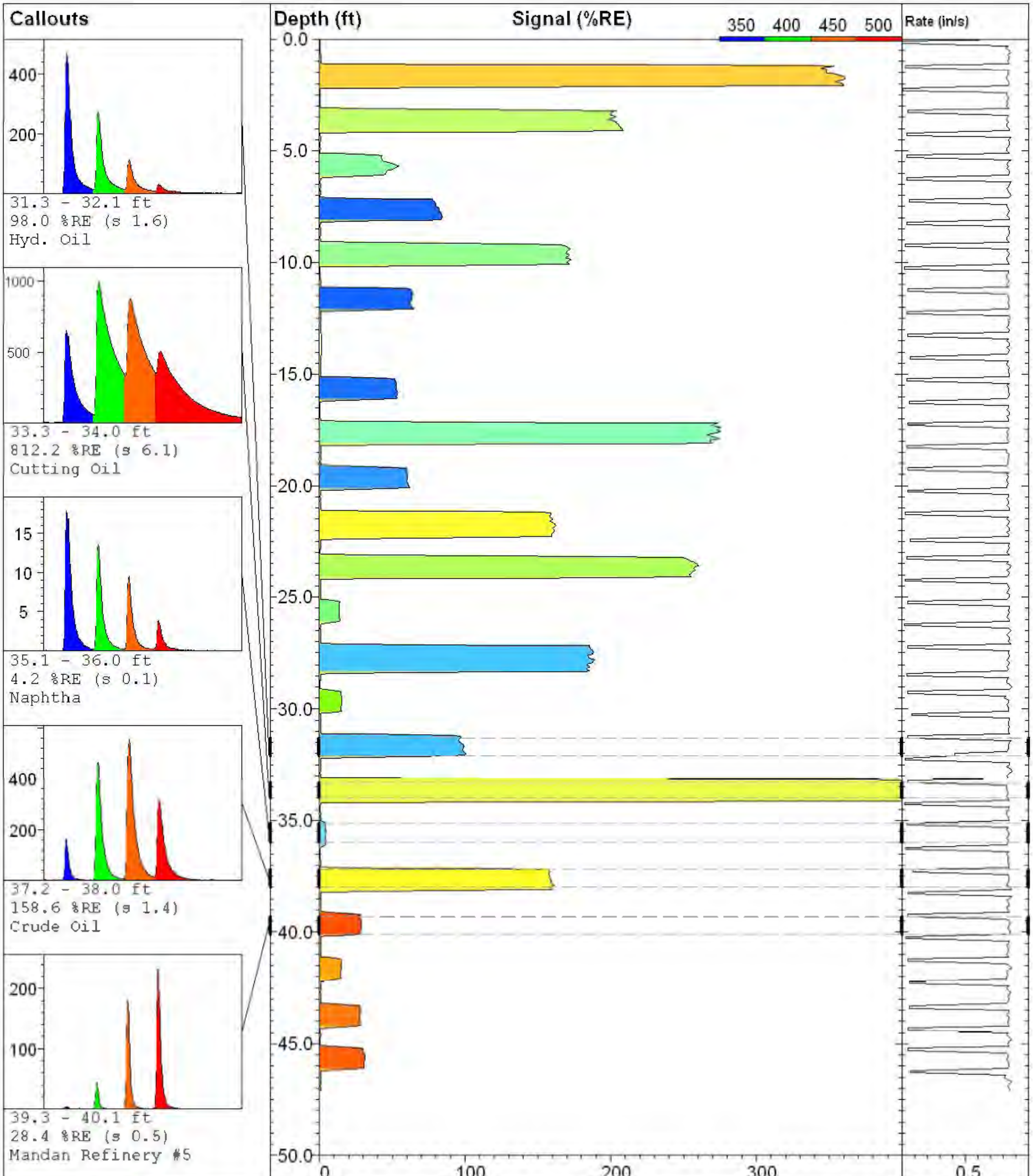


Various products on sand

UVOST By Dakota
www.DakotaTechnologies.com

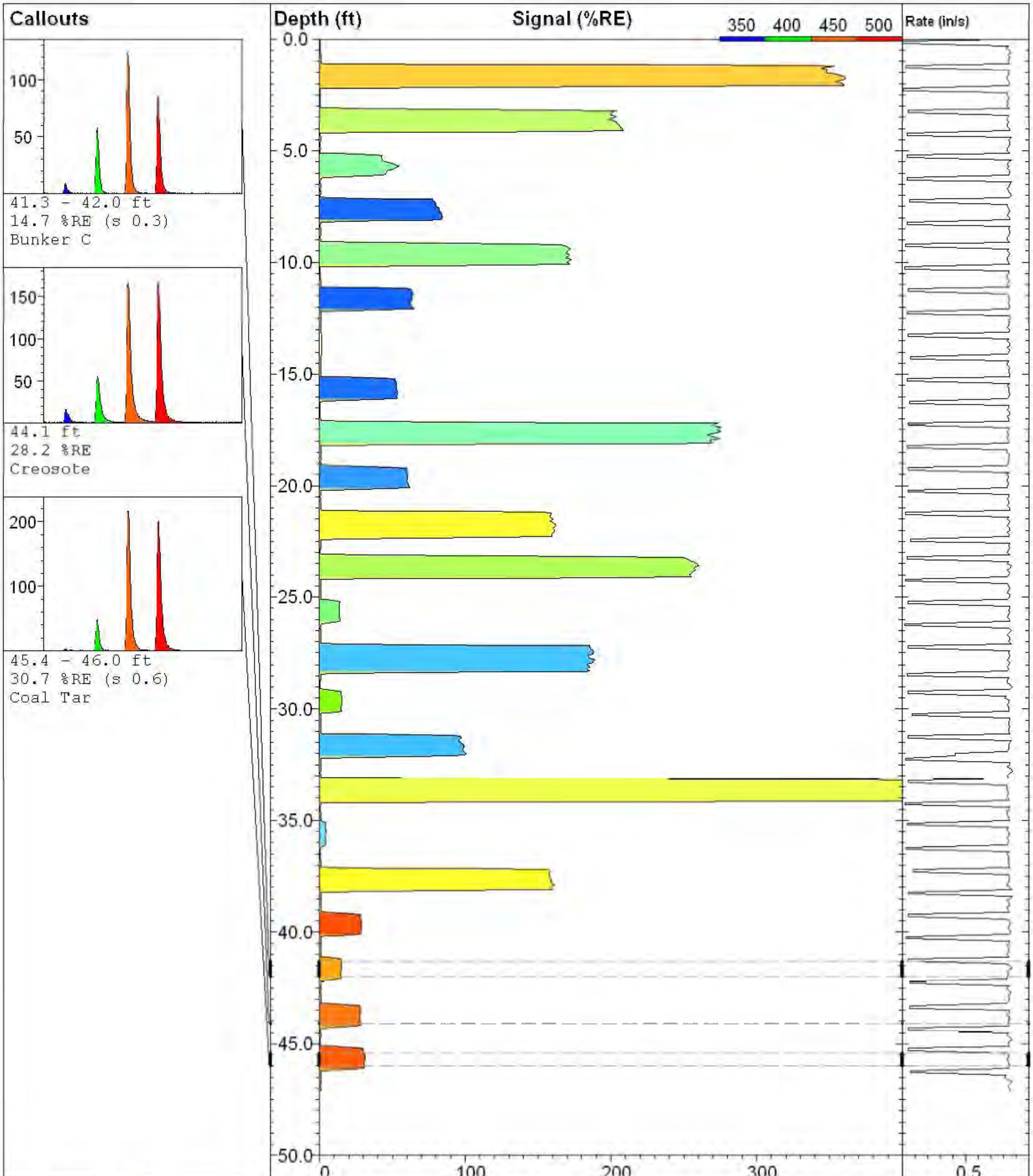
Dakota Technologies, Inc.
Fargo, ND (701)237-4908
www.DakotaTechnologies.com

Site: **Examples**	*Latitude / Datum:* **Unavailable / NA**	*Final depth:* **47.10 ft**
Client: **DTI**	*Longitude / Fix:* **Unavailable / NA**	*Max signal:* **826.6 % @ 33.20 ft**
Job:	*Operator/Unit:* **T.Rudolph/UVOST1002**	*Date & Time:* **2007-08-24 14:25 CDT**



Various products on sand		UVOST By Dakota www.DakotaTechnologies.com
Site: **Examples**	*Latitude / Datum:* **Unavailable / NA**	*Final depth:* **47.10 ft**
Client: **DTI**	*Longitude / Fix:* **Unavailable / NA**	*Max signal:* **826.6 % @ 33.20 ft**
Job:	*Operator/Unit:* **T.Rudolph/UVOST1002**	*Date & Time:* **2007-08-24 14:25 CDT**

Dakota Technologies, Inc.
Fargo, ND (701)237-4908
www.DakotaTechnologies.com



Dakota Technologies, Inc.
Fargo, ND (701)237-4908
www.DakotaTechnologies.com

Various products on sand

UVOST By Dakota
www.DakotaTechnologies.com

Site: **Examples**	*Latitude / Datum:* **Unavailable / NA**	*Final depth:* **47.10 ft**
Client: **DTI**	*Longitude / Fix:* **Unavailable / NA**	*Max signal:* **826.6 % @ 33.20 ft**
Job:	*Operator/Unit:* **T.Rudolph/UVOST1002**	*Date & Time:* **2007-08-24 14:25 CDT**

APPENDIX H – Analytical Lab Results Provided By ALS Environmental Laboratory

10450 Stancliff Rd. Suite 210
Houston, TX 77099
T: +1 281 530 5656
F: +1 281 530 5887

March 28, 2018

Scott Pieper
Columbia Technologies LLC
1795 Cogswell Street
Suite 101
Rockledge,, FL 32955

Work Order: **HS18031138**

Laboratory Results for: **Sac + Fox**

Dear Scott,

ALS Environmental received 26 sample(s) on Mar 23, 2018 for the analysis presented in the following report.

The analytical data provided relates directly to the samples received by ALS Environmental and for only the analyses requested. Results are expressed as "as received" unless otherwise noted.

QC sample results for this data met EPA or laboratory specifications except as noted in the Case Narrative or as noted with qualifiers in the QC batch information. Should this laboratory report need to be reproduced, it should be reproduced in full unless written approval has been obtained by ALS Environmental. Samples will be disposed in 30 days unless storage arrangements are made.

If you have any questions regarding this report, please feel free to call me.

Sincerely,

Generated By: JUMOKE.LAWAL
Corey Grandits
Project Manager

Client: Columbia Technologies LLC
Project: Sac + Fox
Work Order: HS18031138

SAMPLE SUMMARY

Lab Samp ID	Client Sample ID	Matrix	TagNo	Collection Date	Date Received	Hold
HS18031138-01	SB01-11	Soil		22-Mar-2018 12:21	23-Mar-2018 08:50	☐
HS18031138-02	SB01-12	Soil		22-Mar-2018 12:26	23-Mar-2018 08:50	☐
HS18031138-03	SB01-13	Soil		22-Mar-2018 12:31	23-Mar-2018 08:50	☐
HS18031138-04	SB01-14	Soil		22-Mar-2018 12:36	23-Mar-2018 08:50	☐
HS18031138-05	SB01-15	Soil		22-Mar-2018 12:40	23-Mar-2018 08:50	☐
HS18031138-06	SB02-12	Soil		22-Mar-2018 12:55	23-Mar-2018 08:50	☐
HS18031138-07	SB02-14	Soil		22-Mar-2018 13:06	23-Mar-2018 08:50	☐
HS18031138-08	SB02-16	Soil		22-Mar-2018 15:20	23-Mar-2018 08:50	☐
HS18031138-09	SB03-20	Soil		22-Mar-2018 13:26	23-Mar-2018 08:50	☐
HS18031138-10	SB03-21	Soil		22-Mar-2018 13:33	23-Mar-2018 08:50	☐
HS18031138-11	SB03-22	Soil		22-Mar-2018 13:39	23-Mar-2018 08:50	☐
HS18031138-12	SB04-11	Soil		22-Mar-2018 14:05	23-Mar-2018 08:50	☐
HS18031138-13	SB04-12	Soil		22-Mar-2018 14:25	23-Mar-2018 08:50	☐
HS18031138-14	SB04-13	Soil		22-Mar-2018 14:10	23-Mar-2018 08:50	☐
HS18031138-15	SB04-14	Soil		22-Mar-2018 14:15	23-Mar-2018 08:50	☐
HS18031138-16	SB04-15	Soil		22-Mar-2018 14:20	23-Mar-2018 08:50	☐
HS18031138-17	SB04-16	Soil		22-Mar-2018 14:30	23-Mar-2018 08:50	☐
HS18031138-18	SB05-8	Soil		22-Mar-2018 15:10	23-Mar-2018 08:50	☐
HS18031138-19	SB05-9	Soil		22-Mar-2018 15:15	23-Mar-2018 08:50	☐
HS18031138-20	SB05-10	Soil		22-Mar-2018 14:47	23-Mar-2018 08:50	☐
HS18031138-21	SB05-11	Soil		22-Mar-2018 14:51	23-Mar-2018 08:50	☐
HS18031138-22	SB05-12	Soil		22-Mar-2018 14:55	23-Mar-2018 08:50	☐
HS18031138-23	SB05-13	Soil		22-Mar-2018 15:00	23-Mar-2018 08:50	☐
HS18031138-24	SB05-14	Soil		22-Mar-2018 15:06	23-Mar-2018 08:50	☐
HS18031138-25	SB05-15	Soil		22-Mar-2018 14:42	23-Mar-2018 08:50	☐
HS18031138-26	SB05-16	Soil		22-Mar-2018 14:45	23-Mar-2018 08:50	☐

Client: Columbia Technologies LLC
Project: Sac + Fox
Work Order: HS18031138

CASE NARRATIVE

GC Semivolatiles by Method TX1005

Batch ID: 126579,126588

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.

Client:	Columbia Technologies LLC		**ANALYTICAL REPORT**
Project:	Sac + Fox		WorkOrder:HS18031138
Sample ID:	SB01-11		Lab ID:HS18031138-01
Collection Date:	22-Mar-2018 12:21		Matrix:Soil

ANALYSES	RESULT	QUAL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
TEXAS TPH BY TX1005		**Method:TX1005**		Prep:TX1005PR / 26-Mar-2018		Analyst: MBG
nC6 to nC12	ND		38	mg/Kg	1	27-Mar-2018 00:31
>nC12 to nC28	ND		38	mg/Kg	1	27-Mar-2018 00:31
>nC28 to nC35	ND		38	mg/Kg	1	27-Mar-2018 00:31
Total Petroleum Hydrocarbon	ND		38	mg/Kg	1	27-Mar-2018 00:31
Surr: 2-Fluorobiphenyl	*72.5*		*70-130*	*%REC*	*1*	*27-Mar-2018 00:31*
Surr: Trifluoromethyl benzene	*85.4*		*70-130*	*%REC*	*1*	*27-Mar-2018 00:31*

Note: See Qualifiers Page for a list of qualifiers and their explanation.

Client:	Columbia Technologies LLC	ANALYTICAL REPORT
Project:	Sac + Fox	WorkOrder:HS18031138
Sample ID:	SB01-12	Lab ID:HS18031138-02
Collection Date:	22-Mar-2018 12:26	Matrix:Soil

ANALYSES	RESULT	QUAL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
TEXAS TPH BY TX1005		**Method:TX1005**		Prep:TX1005PR / 26-Mar-2018		Analyst: MBG
nC6 to nC12	ND		40	mg/Kg	1	27-Mar-2018 01:00
>nC12 to nC28	ND		40	mg/Kg	1	27-Mar-2018 01:00
>nC28 to nC35	ND		40	mg/Kg	1	27-Mar-2018 01:00
Total Petroleum Hydrocarbon	ND		40	mg/Kg	1	27-Mar-2018 01:00
Surr: 2-Fluorobiphenyl	*71.7*		*70-130*	*%REC*	*1*	*27-Mar-2018 01:00*
Surr: Trifluoromethyl benzene	*78.8*		*70-130*	*%REC*	*1*	*27-Mar-2018 01:00*

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group Houston, Corp Date: 28-Mar-18

Client:	Columbia Technologies LLC		**ANALYTICAL REPORT**
Project:	Sac + Fox		WorkOrder:HS18031138
Sample ID:	SB01-13		Lab ID:HS18031138-03
Collection Date:	22-Mar-2018 12:31		Matrix:Soil

ANALYSES	RESULT	QUAL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
TEXAS TPH BY TX1005		**Method:TX1005**		Prep:TX1005PR / 26-Mar-2018		Analyst: MBG
nC6 to nC12	ND		37	mg/Kg	1	27-Mar-2018 01:29
>nC12 to nC28	**60**		**37**	**mg/Kg**	1	27-Mar-2018 01:29
>nC28 to nC35	ND		37	mg/Kg	1	27-Mar-2018 01:29
Total Petroleum Hydrocarbon	**60.0**		**37**	**mg/Kg**	1	27-Mar-2018 01:29
Surr: 2-Fluorobiphenyl	*70.5*		*70-130*	*%REC*	*1*	*27-Mar-2018 01:29*
Surr: Trifluoromethyl benzene	*78.7*		*70-130*	*%REC*	*1*	*27-Mar-2018 01:29*

Note: See Qualifiers Page for a list of qualifiers and their explanation.

Client:	Columbia Technologies LLC		**ANALYTICAL REPORT**
Project:	Sac + Fox		WorkOrder:HS18031138
Sample ID:	SB01-14		Lab ID:HS18031138-04
Collection Date:	22-Mar-2018 12:36		Matrix:Soil

ANALYSES	RESULT	QUAL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
TEXAS TPH BY TX1005		**Method:TX1005**		Prep:TX1005PR / 26-Mar-2018		Analyst: MBG
nC6 to nC12	**60**		**38**	**mg/Kg**	1	27-Mar-2018 01:58
>nC12 to nC28	**360**		**38**	**mg/Kg**	1	27-Mar-2018 01:58
>nC28 to nC35	ND		38	mg/Kg	1	27-Mar-2018 01:58
Total Petroleum Hydrocarbon	**420**		**38**	**mg/Kg**	1	27-Mar-2018 01:58
Surr: 2-Fluorobiphenyl	*87.4*		*70-130*	*%REC*	*1*	*27-Mar-2018 01:58*
Surr: Trifluoromethyl benzene	*90.7*		*70-130*	*%REC*	*1*	*27-Mar-2018 01:58*

Note: See Qualifiers Page for a list of qualifiers and their explanation.

Client:	Columbia Technologies LLC		**ANALYTICAL REPORT**
Project:	Sac + Fox		WorkOrder:HS18031138
Sample ID:	SB01-15		Lab ID:HS18031138-05
Collection Date:	22-Mar-2018 12:40		Matrix:Soil

ANALYSES	RESULT	QUAL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
TEXAS TPH BY TX1005		**Method:TX1005**		Prep:TX1005PR / 26-Mar-2018		Analyst: MBG
nC6 to nC12	**45**		**38**	**mg/Kg**	1	27-Mar-2018 02:27
>nC12 to nC28	**330**		**38**	**mg/Kg**	1	27-Mar-2018 02:27
>nC28 to nC35	ND		38	mg/Kg	1	27-Mar-2018 02:27
Total Petroleum Hydrocarbon	**375**		**38**	**mg/Kg**	1	27-Mar-2018 02:27
Surr: 2-Fluorobiphenyl	*83.3*		*70-130*	*%REC*	*1*	*27-Mar-2018 02:27*
Surr: Trifluoromethyl benzene	*83.0*		*70-130*	*%REC*	*1*	*27-Mar-2018 02:27*

Note: See Qualifiers Page for a list of qualifiers and their explanation.

Client:	Columbia Technologies LLC		**ANALYTICAL REPORT**
Project:	Sac + Fox		WorkOrder:HS18031138
Sample ID:	SB02-12		Lab ID:HS18031138-06
Collection Date:	22-Mar-2018 12:55		Matrix:Soil

ANALYSES	RESULT	QUAL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
TEXAS TPH BY TX1005		**Method:TX1005**		Prep:TX1005PR / 26-Mar-2018		Analyst: MBG
nC6 to nC12	**190**		**39**	**mg/Kg**	1	27-Mar-2018 02:56
>nC12 to nC28	ND		39	mg/Kg	1	27-Mar-2018 02:56
>nC28 to nC35	ND		39	mg/Kg	1	27-Mar-2018 02:56
Total Petroleum Hydrocarbon	**190**		**39**	**mg/Kg**	1	27-Mar-2018 02:56
Surr: 2-Fluorobiphenyl	*70.3*		*70-130*	*%REC*	*1*	*27-Mar-2018 02:56*
Surr: Trifluoromethyl benzene	*92.2*		*70-130*	*%REC*	*1*	*27-Mar-2018 02:56*

Note: See Qualifiers Page for a list of qualifiers and their explanation.

Client:	Columbia Technologies LLC		**ANALYTICAL REPORT**
Project:	Sac + Fox		WorkOrder:HS18031138
Sample ID:	SB02-14		Lab ID:HS18031138-07
Collection Date:	22-Mar-2018 13:06		Matrix:Soil

ANALYSES	RESULT	QUAL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
TEXAS TPH BY TX1005		**Method:TX1005**		Prep:TX1005PR / 26-Mar-2018		Analyst: MBG
nC6 to nC12	**140**		**38**	**mg/Kg**	1	26-Mar-2018 17:45
>nC12 to nC28	ND		38	mg/Kg	1	26-Mar-2018 17:45
>nC28 to nC35	ND		38	mg/Kg	1	26-Mar-2018 17:45
Total Petroleum Hydrocarbon	**140**		**38**	**mg/Kg**	1	26-Mar-2018 17:45
Surr: 2-Fluorobiphenyl	*70.6*		*70-130*	*%REC*	*1*	*26-Mar-2018 17:45*
Surr: Trifluoromethyl benzene	*97.3*		*70-130*	*%REC*	*1*	*26-Mar-2018 17:45*

Note: See Qualifiers Page for a list of qualifiers and their explanation.

Client:	Columbia Technologies LLC		**ANALYTICAL REPORT**
Project:	Sac + Fox		WorkOrder:HS18031138
Sample ID:	SB02-16		Lab ID:HS18031138-08
Collection Date:	22-Mar-2018 15:20		Matrix:Soil

ANALYSES	RESULT	QUAL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
TEXAS TPH BY TX1005		**Method:TX1005**		Prep:TX1005PR / 26-Mar-2018		Analyst: MBG
nC6 to nC12	ND		39	mg/Kg	1	27-Mar-2018 03:25
>nC12 to nC28	ND		39	mg/Kg	1	27-Mar-2018 03:25
>nC28 to nC35	ND		39	mg/Kg	1	27-Mar-2018 03:25
Total Petroleum Hydrocarbon	ND		39	mg/Kg	1	27-Mar-2018 03:25
Surr: 2-Fluorobiphenyl	*71.4*		*70-130*	*%REC*	*1*	*27-Mar-2018 03:25*
Surr: Trifluoromethyl benzene	*79.2*		*70-130*	*%REC*	*1*	*27-Mar-2018 03:25*

Note: See Qualifiers Page for a list of qualifiers and their explanation.

Client:	Columbia Technologies LLC		**ANALYTICAL REPORT**
Project:	Sac + Fox		WorkOrder:HS18031138
Sample ID:	SB03-20		Lab ID:HS18031138-09
Collection Date:	22-Mar-2018 13:26		Matrix:Soil

ANALYSES	RESULT	QUAL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
TEXAS TPH BY TX1005		**Method:TX1005**		Prep:TX1005PR / 26-Mar-2018		Analyst: MBG
nC6 to nC12	ND		38	mg/Kg	1	27-Mar-2018 03:55
>nC12 to nC28	ND		38	mg/Kg	1	27-Mar-2018 03:55
>nC28 to nC35	ND		38	mg/Kg	1	27-Mar-2018 03:55
Total Petroleum Hydrocarbon	ND		38	mg/Kg	1	27-Mar-2018 03:55
Surr: 2-Fluorobiphenyl	*72.9*		*70-130*	*%REC*	*1*	*27-Mar-2018 03:55*
Surr: Trifluoromethyl benzene	*80.7*		*70-130*	*%REC*	*1*	*27-Mar-2018 03:55*

Note: See Qualifiers Page for a list of qualifiers and their explanation.

Client:	Columbia Technologies LLC		**ANALYTICAL REPORT**
Project:	Sac + Fox		WorkOrder:HS18031138
Sample ID:	SB03-21		Lab ID:HS18031138-10
Collection Date:	22-Mar-2018 13:33		Matrix:Soil

ANALYSES	RESULT	QUAL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
TEXAS TPH BY TX1005		**Method:TX1005**		Prep:TX1005PR / 26-Mar-2018		Analyst: MBG
nC6 to nC12	ND		38	mg/Kg	1	27-Mar-2018 04:24
>nC12 to nC28	ND		38	mg/Kg	1	27-Mar-2018 04:24
>nC28 to nC35	ND		38	mg/Kg	1	27-Mar-2018 04:24
Total Petroleum Hydrocarbon	ND		38	mg/Kg	1	27-Mar-2018 04:24
Surr: 2-Fluorobiphenyl	*72.1*		*70-130*	*%REC*	*1*	*27-Mar-2018 04:24*
Surr: Trifluoromethyl benzene	*71.8*		*70-130*	*%REC*	*1*	*27-Mar-2018 04:24*

Note: See Qualifiers Page for a list of qualifiers and their explanation.

Client:	Columbia Technologies LLC		**ANALYTICAL REPORT**
Project:	Sac + Fox		WorkOrder:HS18031138
Sample ID:	SB03-22		Lab ID:HS18031138-11
Collection Date:	22-Mar-2018 13:39		Matrix:Soil

ANALYSES	RESULT	QUAL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
TEXAS TPH BY TX1005		**Method:TX1005**		Prep:TX1005PR / 26-Mar-2018		Analyst: MBG
nC6 to nC12	ND		37	mg/Kg	1	27-Mar-2018 04:53
>nC12 to nC28	ND		37	mg/Kg	1	27-Mar-2018 04:53
>nC28 to nC35	ND		37	mg/Kg	1	27-Mar-2018 04:53
Total Petroleum Hydrocarbon	ND		37	mg/Kg	1	27-Mar-2018 04:53
Surr: 2-Fluorobiphenyl	*78.9*		*70-130*	*%REC*	*1*	*27-Mar-2018 04:53*
Surr: Trifluoromethyl benzene	*90.3*		*70-130*	*%REC*	*1*	*27-Mar-2018 04:53*

Note: See Qualifiers Page for a list of qualifiers and their explanation.

Client:	Columbia Technologies LLC		**ANALYTICAL REPORT**
Project:	Sac + Fox		WorkOrder:HS18031138
Sample ID:	SB04-11		Lab ID:HS18031138-12
Collection Date:	22-Mar-2018 14:05		Matrix:Soil

ANALYSES	RESULT	QUAL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
TEXAS TPH BY TX1005		**Method:TX1005**		Prep:TX1005PR / 26-Mar-2018		Analyst: MBG
nC6 to nC12	ND		39	mg/Kg	1	27-Mar-2018 15:45
>nC12 to nC28	ND		39	mg/Kg	1	27-Mar-2018 15:45
>nC28 to nC35	ND		39	mg/Kg	1	27-Mar-2018 15:45
Total Petroleum Hydrocarbon	ND		39	mg/Kg	1	27-Mar-2018 15:45
Surr: 2-Fluorobiphenyl	*75.4*		*70-130*	*%REC*	*1*	*27-Mar-2018 15:45*
Surr: Trifluoromethyl benzene	*85.1*		*70-130*	*%REC*	*1*	*27-Mar-2018 15:45*

Note: See Qualifiers Page for a list of qualifiers and their explanation.

Client:	Columbia Technologies LLC		**ANALYTICAL REPORT**
Project:	Sac + Fox		WorkOrder:HS18031138
Sample ID:	SB04-12		Lab ID:HS18031138-13
Collection Date:	22-Mar-2018 14:25		Matrix:Soil

ANALYSES	RESULT	QUAL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
TEXAS TPH BY TX1005		**Method:TX1005**		Prep:TX1005PR / 26-Mar-2018		Analyst: MBG
nC6 to nC12	ND		38	mg/Kg	1	27-Mar-2018 16:13
>nC12 to nC28	ND		38	mg/Kg	1	27-Mar-2018 16:13
>nC28 to nC35	ND		38	mg/Kg	1	27-Mar-2018 16:13
Total Petroleum Hydrocarbon	ND		38	mg/Kg	1	27-Mar-2018 16:13
Surr: 2-Fluorobiphenyl	*73.3*		*70-130*	*%REC*	*1*	*27-Mar-2018 16:13*
Surr: Trifluoromethyl benzene	*84.4*		*70-130*	*%REC*	*1*	*27-Mar-2018 16:13*

Note: See Qualifiers Page for a list of qualifiers and their explanation.

Client:	Columbia Technologies LLC		**ANALYTICAL REPORT**
Project:	Sac + Fox		WorkOrder:HS18031138
Sample ID:	SB04-13		Lab ID:HS18031138-14
Collection Date:	22-Mar-2018 14:10		Matrix:Soil

ANALYSES	RESULT	QUAL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
TEXAS TPH BY TX1005		**Method:TX1005**		Prep:TX1005PR / 26-Mar-2018		Analyst: MBG
nC6 to nC12	ND		39	mg/Kg	1	27-Mar-2018 16:42
>nC12 to nC28	ND		39	mg/Kg	1	27-Mar-2018 16:42
>nC28 to nC35	ND		39	mg/Kg	1	27-Mar-2018 16:42
Total Petroleum Hydrocarbon	ND		39	mg/Kg	1	27-Mar-2018 16:42
Surr: 2-Fluorobiphenyl	*73.0*		*70-130*	*%REC*	*1*	*27-Mar-2018 16:42*
Surr: Trifluoromethyl benzene	*82.4*		*70-130*	*%REC*	*1*	*27-Mar-2018 16:42*

Note: See Qualifiers Page for a list of qualifiers and their explanation.

Client:	Columbia Technologies LLC		**ANALYTICAL REPORT**
Project:	Sac + Fox		WorkOrder:HS18031138
Sample ID:	SB04-14		Lab ID:HS18031138-15
Collection Date:	22-Mar-2018 14:15		Matrix:Soil

ANALYSES	RESULT	QUAL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
TEXAS TPH BY TX1005		**Method:TX1005**		Prep:TX1005PR / 26-Mar-2018		Analyst: MBG
nC6 to nC12	ND		36	mg/Kg	1	27-Mar-2018 17:11
>nC12 to nC28	ND		36	mg/Kg	1	27-Mar-2018 17:11
>nC28 to nC35	ND		36	mg/Kg	1	27-Mar-2018 17:11
Total Petroleum Hydrocarbon	ND		36	mg/Kg	1	27-Mar-2018 17:11
Surr: 2-Fluorobiphenyl	*77.4*		*70-130*	*%REC*	*1*	*27-Mar-2018 17:11*
Surr: Trifluoromethyl benzene	*88.1*		*70-130*	*%REC*	*1*	*27-Mar-2018 17:11*

Note: See Qualifiers Page for a list of qualifiers and their explanation.

Client:	Columbia Technologies LLC		**ANALYTICAL REPORT**
Project:	Sac + Fox		WorkOrder:HS18031138
Sample ID:	SB04-15		Lab ID:HS18031138-16
Collection Date:	22-Mar-2018 14:20		Matrix:Soil

ANALYSES	RESULT	QUAL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
TEXAS TPH BY TX1005		**Method:TX1005**		Prep:TX1005PR / 26-Mar-2018		Analyst: MBG
nC6 to nC12	ND		39	mg/Kg	1	27-Mar-2018 17:40
>nC12 to nC28	ND		39	mg/Kg	1	27-Mar-2018 17:40
>nC28 to nC35	ND		39	mg/Kg	1	27-Mar-2018 17:40
Total Petroleum Hydrocarbon	ND		39	mg/Kg	1	27-Mar-2018 17:40
Surr: 2-Fluorobiphenyl	*75.2*		*70-130*	*%REC*	*1*	*27-Mar-2018 17:40*
Surr: Trifluoromethyl benzene	*86.2*		*70-130*	*%REC*	*1*	*27-Mar-2018 17:40*

Note: See Qualifiers Page for a list of qualifiers and their explanation.

Client:	Columbia Technologies LLC		**ANALYTICAL REPORT**
Project:	Sac + Fox		WorkOrder:HS18031138
Sample ID:	SB04-16		Lab ID:HS18031138-17
Collection Date:	22-Mar-2018 14:30		Matrix:Soil

ANALYSES	RESULT	QUAL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
TEXAS TPH BY TX1005		**Method:TX1005**		Prep:TX1005PR / 26-Mar-2018		Analyst: MBG
nC6 to nC12	ND		40	mg/Kg	1	27-Mar-2018 18:09
>nC12 to nC28	ND		40	mg/Kg	1	27-Mar-2018 18:09
>nC28 to nC35	ND		40	mg/Kg	1	27-Mar-2018 18:09
Total Petroleum Hydrocarbon	ND		40	mg/Kg	1	27-Mar-2018 18:09
Surr: 2-Fluorobiphenyl	*76.1*		*70-130*	*%REC*	*1*	*27-Mar-2018 18:09*
Surr: Trifluoromethyl benzene	*85.6*		*70-130*	*%REC*	*1*	*27-Mar-2018 18:09*

Note: See Qualifiers Page for a list of qualifiers and their explanation.

Client:	Columbia Technologies LLC		**ANALYTICAL REPORT**
Project:	Sac + Fox		WorkOrder:HS18031138
Sample ID:	SB05-8		Lab ID:HS18031138-18
Collection Date:	22-Mar-2018 15:10		Matrix:Soil

ANALYSES	RESULT	QUAL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
TEXAS TPH BY TX1005		**Method:TX1005**		Prep:TX1005PR / 26-Mar-2018		Analyst: MBG
nC6 to nC12	**130**		**40**	**mg/Kg**	1	27-Mar-2018 18:38
>nC12 to nC28	ND		40	mg/Kg	1	27-Mar-2018 18:38
>nC28 to nC35	ND		40	mg/Kg	1	27-Mar-2018 18:38
Total Petroleum Hydrocarbon	**130**		**40**	**mg/Kg**	1	27-Mar-2018 18:38
Surr: 2-Fluorobiphenyl	*76.6*		*70-130*	*%REC*	*1*	*27-Mar-2018 18:38*
Surr: Trifluoromethyl benzene	*86.1*		*70-130*	*%REC*	*1*	*27-Mar-2018 18:38*

Note: See Qualifiers Page for a list of qualifiers and their explanation.

Client:	Columbia Technologies LLC		**ANALYTICAL REPORT**
Project:	Sac + Fox		WorkOrder:HS18031138
Sample ID:	SB05-9		Lab ID:HS18031138-19
Collection Date:	22-Mar-2018 15:15		Matrix:Soil

ANALYSES	RESULT	QUAL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
TEXAS TPH BY TX1005		**Method:TX1005**		Prep:TX1005PR / 26-Mar-2018		Analyst: MBG
nC6 to nC12	**110**		**38**	**mg/Kg**	1	27-Mar-2018 19:07
>nC12 to nC28	ND		38	mg/Kg	1	27-Mar-2018 19:07
>nC28 to nC35	ND		38	mg/Kg	1	27-Mar-2018 19:07
Total Petroleum Hydrocarbon	**110**		**38**	**mg/Kg**	1	27-Mar-2018 19:07
Surr: 2-Fluorobiphenyl	*80.0*		*70-130*	*%REC*	*1*	*27-Mar-2018 19:07*
Surr: Trifluoromethyl benzene	*87.2*		*70-130*	*%REC*	*1*	*27-Mar-2018 19:07*

Note: See Qualifiers Page for a list of qualifiers and their explanation.

Client:	Columbia Technologies LLC		**ANALYTICAL REPORT**
Project:	Sac + Fox		WorkOrder:HS18031138
Sample ID:	SB05-10		Lab ID:HS18031138-20
Collection Date:	22-Mar-2018 14:47		Matrix:Soil

ANALYSES	RESULT	QUAL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
TEXAS TPH BY TX1005		**Method:TX1005**		Prep:TX1005PR / 26-Mar-2018		Analyst: MBG
nC6 to nC12	ND		38	mg/Kg	1	27-Mar-2018 19:36
>nC12 to nC28	ND		38	mg/Kg	1	27-Mar-2018 19:36
>nC28 to nC35	ND		38	mg/Kg	1	27-Mar-2018 19:36
Total Petroleum Hydrocarbon	ND		38	mg/Kg	1	27-Mar-2018 19:36
Surr: 2-Fluorobiphenyl	*75.8*		*70-130*	*%REC*	*1*	*27-Mar-2018 19:36*
Surr: Trifluoromethyl benzene	*86.9*		*70-130*	*%REC*	*1*	*27-Mar-2018 19:36*

Note: See Qualifiers Page for a list of qualifiers and their explanation.

Client:	Columbia Technologies LLC		**ANALYTICAL REPORT**
Project:	Sac + Fox		WorkOrder:HS18031138
Sample ID:	SB05-11		Lab ID:HS18031138-21
Collection Date:	22-Mar-2018 14:51		Matrix:Soil

ANALYSES	RESULT	QUAL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
TEXAS TPH BY TX1005		**Method:TX1005**		Prep:TX1005PR / 26-Mar-2018		Analyst: MBG
nC6 to nC12	ND		39	mg/Kg	1	27-Mar-2018 20:05
>nC12 to nC28	ND		39	mg/Kg	1	27-Mar-2018 20:05
>nC28 to nC35	ND		39	mg/Kg	1	27-Mar-2018 20:05
Total Petroleum Hydrocarbon	ND		39	mg/Kg	1	27-Mar-2018 20:05
Surr: 2-Fluorobiphenyl	*78.8*		*70-130*	*%REC*	*1*	*27-Mar-2018 20:05*
Surr: Trifluoromethyl benzene	*89.5*		*70-130*	*%REC*	*1*	*27-Mar-2018 20:05*

Note: See Qualifiers Page for a list of qualifiers and their explanation.

Client:	Columbia Technologies LLC		ANALYTICAL REPORT
Project:	Sac + Fox		WorkOrder:HS18031138
Sample ID:	SB05-12		Lab ID:HS18031138-22
Collection Date:	22-Mar-2018 14:55		Matrix:Soil

ANALYSES	RESULT	QUAL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
TEXAS TPH BY TX1005		**Method:TX1005**		Prep:TX1005PR / 26-Mar-2018		Analyst: MBG
nC6 to nC12	ND		38	mg/Kg	1	27-Mar-2018 10:55
>nC12 to nC28	ND		38	mg/Kg	1	27-Mar-2018 10:55
>nC28 to nC35	ND		38	mg/Kg	1	27-Mar-2018 10:55
Total Petroleum Hydrocarbon	ND		38	mg/Kg	1	27-Mar-2018 10:55
Surr: 2-Fluorobiphenyl	*74.0*		*70-130*	*%REC*	*1*	*27-Mar-2018 10:55*
Surr: Trifluoromethyl benzene	*84.2*		*70-130*	*%REC*	*1*	*27-Mar-2018 10:55*

Note: See Qualifiers Page for a list of qualifiers and their explanation.

Client:	Columbia Technologies LLC		**ANALYTICAL REPORT**
Project:	Sac + Fox		WorkOrder:HS18031138
Sample ID:	SB05-13		Lab ID:HS18031138-23
Collection Date:	22-Mar-2018 15:00		Matrix:Soil

ANALYSES	RESULT	QUAL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
TEXAS TPH BY TX1005		**Method:TX1005**		Prep:TX1005PR / 26-Mar-2018		Analyst: MBG
nC6 to nC12	ND		38	mg/Kg	1	27-Mar-2018 20:34
>nC12 to nC28	ND		38	mg/Kg	1	27-Mar-2018 20:34
>nC28 to nC35	ND		38	mg/Kg	1	27-Mar-2018 20:34
Total Petroleum Hydrocarbon	ND		38	mg/Kg	1	27-Mar-2018 20:34
Surr: 2-Fluorobiphenyl	*74.6*		*70-130*	*%REC*	*1*	*27-Mar-2018 20:34*
Surr: Trifluoromethyl benzene	*83.8*		*70-130*	*%REC*	*1*	*27-Mar-2018 20:34*

Note: See Qualifiers Page for a list of qualifiers and their explanation.

Client:	Columbia Technologies LLC	**ANALYTICAL REPORT**
Project:	Sac + Fox	WorkOrder:HS18031138
Sample ID:	SB05-14	Lab ID:HS18031138-24
Collection Date:	22-Mar-2018 15:06	Matrix:Soil

ANALYSES	RESULT	QUAL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
TEXAS TPH BY TX1005		**Method:TX1005**		Prep:TX1005PR / 26-Mar-2018		Analyst: MBG
nC6 to nC12	ND		39	mg/Kg	1	27-Mar-2018 21:02
>nC12 to nC28	ND		39	mg/Kg	1	27-Mar-2018 21:02
>nC28 to nC35	ND		39	mg/Kg	1	27-Mar-2018 21:02
Total Petroleum Hydrocarbon	ND		39	mg/Kg	1	27-Mar-2018 21:02
Surr: 2-Fluorobiphenyl	*75.4*		*70-130*	*%REC*	*1*	*27-Mar-2018 21:02*
Surr: Trifluoromethyl benzene	*83.8*		*70-130*	*%REC*	*1*	*27-Mar-2018 21:02*

Note: See Qualifiers Page for a list of qualifiers and their explanation.

Client:	Columbia Technologies LLC		**ANALYTICAL REPORT**
Project:	Sac + Fox		WorkOrder:HS18031138
Sample ID:	SB05-15		Lab ID:HS18031138-25
Collection Date:	22-Mar-2018 14:42		Matrix:Soil

ANALYSES	RESULT	QUAL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
TEXAS TPH BY TX1005		**Method:TX1005**		Prep:TX1005PR / 26-Mar-2018		Analyst: MBG
nC6 to nC12	ND		39	mg/Kg	1	27-Mar-2018 21:31
>nC12 to nC28	ND		39	mg/Kg	1	27-Mar-2018 21:31
>nC28 to nC35	ND		39	mg/Kg	1	27-Mar-2018 21:31
Total Petroleum Hydrocarbon	ND		39	mg/Kg	1	27-Mar-2018 21:31
Surr: 2-Fluorobiphenyl	*72.6*		*70-130*	*%REC*	*1*	*27-Mar-2018 21:31*
Surr: Trifluoromethyl benzene	*84.3*		*70-130*	*%REC*	*1*	*27-Mar-2018 21:31*

Note: See Qualifiers Page for a list of qualifiers and their explanation.

Client:	Columbia Technologies LLC	**ANALYTICAL REPORT**
Project:	Sac + Fox	WorkOrder:HS18031138
Sample ID:	SB05-16	Lab ID:HS18031138-26
Collection Date:	22-Mar-2018 14:45	Matrix:Soil

ANALYSES	RESULT	QUAL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
TEXAS TPH BY TX1005		**Method:TX1005**		Prep:TX1005PR / 26-Mar-2018		Analyst: MBG
nC6 to nC12	ND		38	mg/Kg	1	27-Mar-2018 22:59
>nC12 to nC28	ND		38	mg/Kg	1	27-Mar-2018 22:59
>nC28 to nC35	ND		38	mg/Kg	1	27-Mar-2018 22:59
Total Petroleum Hydrocarbon	ND		38	mg/Kg	1	27-Mar-2018 22:59
Surr: 2-Fluorobiphenyl	*74.0*		*70-130*	*%REC*	*1*	*27-Mar-2018 22:59*
Surr: Trifluoromethyl benzene	*84.6*		*70-130*	*%REC*	*1*	*27-Mar-2018 22:59*

Note: See Qualifiers Page for a list of qualifiers and their explanation.

WEIGHT LOG

Client: Columbia Technologies LLC
Project: Sac + Fox
WorkOrder: HS18031138

Batch ID: 126579 **Method:** TEXAS TPH BY TX1005 **Prep:** TX 1005_S PR

SampID	Container	Sample Wt/Vol	Final Volume	Prep Factor
HS18031138-01	1	13.28	10 (mL)	0.753
HS18031138-02	1	12.42	10 (mL)	0.8052
HS18031138-03	1	13.38	10 (mL)	0.7474
HS18031138-04	1	13.07	10 (mL)	0.7651
HS18031138-05	1	13.17	10 (mL)	0.7593
HS18031138-06	1	12.95	10 (mL)	0.7722
HS18031138-07	1	13.24	10 (mL)	0.7553
HS18031138-08	1	12.73	10 (mL)	0.7855
HS18031138-09	1	13.06	10 (mL)	0.7657
HS18031138-10	1	13.33	10 (mL)	0.7502
HS18031138-11	1	13.68	10 (mL)	0.731

Batch ID: 126588 **Method:** TEXAS TPH BY TX1005 **Prep:** TX 1005_S PR

SampID	Container	Sample Wt/Vol	Final Volume	Prep Factor
HS18031138-12	1	12.81	10 (mL)	0.7806
HS18031138-13	1	13.13	10 (mL)	0.7616
HS18031138-14	1	12.79	10 (mL)	0.7819
HS18031138-15	1	13.8	10 (mL)	0.7246
HS18031138-16	1	12.85	10 (mL)	0.7782
HS18031138-17	1	12.62	10 (mL)	0.7924
HS18031138-18	1	12.49	10 (mL)	0.8006
HS18031138-19	1	13.14	10 (mL)	0.761
HS18031138-20	1	13.13	10 (mL)	0.7616
HS18031138-21	1	12.92	10 (mL)	0.774
HS18031138-22	1	13.3	10 (mL)	0.7519
HS18031138-23	1	13.28	10 (mL)	0.753
HS18031138-24	1	12.78	10 (mL)	0.7825
HS18031138-25	1	12.69	10 (mL)	0.788
HS18031138-26	1	13.32	10 (mL)	0.7508

Client: Columbia Technologies LLC
Project: Sac + Fox
WorkOrder: HS18031138

DATES REPORT

Sample ID	Client Samp ID	Collection Date	TCLP Date	Prep Date	Analysis Date	DF
Batch ID 126579	**Test Name :** TEXAS TPH BY TX1005			**Matrix:** Soil		
HS18031138-01	SB01-11	22 Mar 2018 12:21		26 Mar 2018 09:48	27 Mar 2018 00:31	1
HS18031138-02	SB01-12	22 Mar 2018 12:26		26 Mar 2018 09:48	27 Mar 2018 01:00	1
HS18031138-03	SB01-13	22 Mar 2018 12:31		26 Mar 2018 09:48	27 Mar 2018 01:29	1
HS18031138-04	SB01-14	22 Mar 2018 12:36		26 Mar 2018 09:48	27 Mar 2018 01:58	1
HS18031138-05	SB01-15	22 Mar 2018 12:40		26 Mar 2018 09:48	27 Mar 2018 02:27	1
HS18031138-06	SB02-12	22 Mar 2018 12:55		26 Mar 2018 09:48	27 Mar 2018 02:56	1
HS18031138-07	SB02-14	22 Mar 2018 13:06		26 Mar 2018 09:48	26 Mar 2018 17:45	1
HS18031138-08	SB02-16	22 Mar 2018 15:20		26 Mar 2018 09:48	27 Mar 2018 03:25	1
HS18031138-09	SB03-20	22 Mar 2018 13:26		26 Mar 2018 09:48	27 Mar 2018 03:55	1
HS18031138-10	SB03-21	22 Mar 2018 13:33		26 Mar 2018 09:48	27 Mar 2018 04:24	1
HS18031138-11	SB03-22	22 Mar 2018 13:39		26 Mar 2018 09:48	27 Mar 2018 04:53	1
Batch ID 126588	**Test Name :** TEXAS TPH BY TX1005			**Matrix:** Soil		
HS18031138-12	SB04-11	22 Mar 2018 14:05		26 Mar 2018 11:27	27 Mar 2018 15:45	1
HS18031138-13	SB04-12	22 Mar 2018 14:25		26 Mar 2018 11:27	27 Mar 2018 16:13	1
HS18031138-14	SB04-13	22 Mar 2018 14:10		26 Mar 2018 11:27	27 Mar 2018 16:42	1
HS18031138-15	SB04-14	22 Mar 2018 14:15		26 Mar 2018 11:27	27 Mar 2018 17:11	1
HS18031138-16	SB04-15	22 Mar 2018 14:20		26 Mar 2018 11:27	27 Mar 2018 17:40	1
HS18031138-17	SB04-16	22 Mar 2018 14:30		26 Mar 2018 11:27	27 Mar 2018 18:09	1
HS18031138-18	SB05-8	22 Mar 2018 15:10		26 Mar 2018 11:27	27 Mar 2018 18:38	1
HS18031138-19	SB05-9	22 Mar 2018 15:15		26 Mar 2018 11:27	27 Mar 2018 19:07	1
HS18031138-20	SB05-10	22 Mar 2018 14:47		26 Mar 2018 11:27	27 Mar 2018 19:36	1
HS18031138-21	SB05-11	22 Mar 2018 14:51		26 Mar 2018 11:27	27 Mar 2018 20:05	1
HS18031138-22	SB05-12	22 Mar 2018 14:55		26 Mar 2018 11:27	27 Mar 2018 10:55	1
HS18031138-23	SB05-13	22 Mar 2018 15:00		26 Mar 2018 11:27	27 Mar 2018 20:34	1
HS18031138-24	SB05-14	22 Mar 2018 15:06		26 Mar 2018 11:27	27 Mar 2018 21:02	1
HS18031138-25	SB05-15	22 Mar 2018 14:42		26 Mar 2018 11:27	27 Mar 2018 21:31	1
HS18031138-26	SB05-16	22 Mar 2018 14:45		26 Mar 2018 11:27	27 Mar 2018 22:59	1

Client: Columbia Technologies LLC
Project: Sac + Fox
WorkOrder: HS18031138

QC BATCH REPORT

Batch ID: 126579 **Instrument:** FID-13 **Method:** TX1005

MBLK Sample ID: **MBLK-126579** Units: **mg/Kg** Analysis Date: **26-Mar-2018 16:18**
Client ID: Run ID: **FID-13_313166** SeqNo: **4489719** PrepDate: **26-Mar-2018** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
nC6 to nC12	ND	50								
>nC12 to nC28	ND	50								
>nC28 to nC35	ND	50								
Total Petroleum Hydrocarbon	ND	50								
Surr: 2-Fluorobiphenyl	*17.72*	*0*	*25*	*0*	*70.9*	*70 - 130*				
Surr: Trifluoromethyl benzene	*19.04*	*0*	*25*	*0*	*76.2*	*70 - 130*				

LCS Sample ID: **LCS-126579** Units: **mg/Kg** Analysis Date: **26-Mar-2018 16:47**
Client ID: Run ID: **FID-13_313166** SeqNo: **4489720** PrepDate: **26-Mar-2018** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
nC6 to nC12	248.9	50	250	0	99.6	75 - 125				
>nC12 to nC28	244.4	50	250	0	97.8	75 - 125				
Surr: 2-Fluorobiphenyl	*19.85*	*0*	*25*	*0*	*79.4*	*70 - 130*				
Surr: Trifluoromethyl benzene	*24.99*	*0*	*25*	*0*	*100.0*	*70 - 130*				

LCSD Sample ID: **LCSD-126579** Units: **mg/Kg** Analysis Date: **26-Mar-2018 17:16**
Client ID: Run ID: **FID-13_313166** SeqNo: **4489721** PrepDate: **26-Mar-2018** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
nC6 to nC12	278.4	50	250	0	111	75 - 125	248.9	11.2	20	
>nC12 to nC28	268.4	50	250	0	107	75 - 125	244.4	9.34	20	
Surr: 2-Fluorobiphenyl	*21.85*	*0*	*25*	*0*	*87.4*	*70 - 130*	*19.85*	*9.62*	*20*	
Surr: Trifluoromethyl benzene	*27.31*	*0*	*25*	*0*	*109*	*70 - 130*	*24.99*	*8.88*	*20*	

MS Sample ID: **HS18031138-07MS** Units: **mg/Kg** Analysis Date: **26-Mar-2018 18:14**
Client ID: **SB02-14** Run ID: **FID-13_313166** SeqNo: **4489753** PrepDate: **26-Mar-2018** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
nC6 to nC12	295.6	38	191.6	142.8	79.8	75 - 125				
>nC12 to nC28	227.9	38	191.6	0	119	75 - 125				
Surr: 2-Fluorobiphenyl	*15.32*	*0*	*19.16*	*0*	*80.0*	*70 - 130*				
Surr: Trifluoromethyl benzene	*20.2*	*0*	*19.16*	*0*	*105*	*70 - 130*				

Note: See Qualifiers Page for a list of qualifiers and their explanation.

Client:	Columbia Technologies LLC	**QC BATCH REPORT**
Project:	Sac + Fox	
WorkOrder:	HS18031138	

Batch ID: 126579 **Instrument:** FID-13 **Method:** TX1005

MSD Sample ID: **HS18031138-07MSD** Units: **mg/Kg** Analysis Date: **26-Mar-2018 18:43**

Client ID: **SB02-14** Run ID: **FID-13_313166** SeqNo: **4489724** PrepDate: **26-Mar-2018** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
nC6 to nC12	301.8	38	191.1	142.8	83.2	75 - 125	295.6	2.07	20	
>nC12 to nC28	213.4	38	191.1	0	112	75 - 125	227.9	6.57	20	
Surr: 2-Fluorobiphenyl	*16.09*	*0*	*19.11*	*0*	*84.2*	*70 - 130*	*15.32*	*4.92*	*20*	
Surr: Trifluoromethyl benzene	*20.45*	*0*	*19.11*	*0*	*107*	*70 - 130*	*20.2*	*1.23*	*20*	

The following samples were analyzed in this batch:

HS18031138-01	HS18031138-02	HS18031138-03	HS18031138-04
HS18031138-05	HS18031138-06	HS18031138-07	HS18031138-08
HS18031138-09	HS18031138-10	HS18031138-11	

Note: See Qualifiers Page for a list of qualifiers and their explanation.

Client: Columbia Technologies LLC
Project: Sac + Fox
WorkOrder: HS18031138

QC BATCH REPORT

Batch ID: 126588 **Instrument:** FID-10 **Method:** TX1005

MBLK Sample ID: **MBLK-126588** Units: **mg/Kg** Analysis Date: **27-Mar-2018 09:28**
Client ID: Run ID: **FID-10_313250** SeqNo: **4491753** PrepDate: **26-Mar-2018** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
nC6 to nC12	ND	50								
>nC12 to nC28	ND	50								
>nC28 to nC35	ND	50								
Total Petroleum Hydrocarbon	ND	50								
Surr: 2-Fluorobiphenyl	*20.87*	*0*	*25*	*0*	*83.5*	*70 - 130*				
Surr: Trifluoromethyl benzene	*22.89*	*0*	*25*	*0*	*91.5*	*70 - 130*				

LCS Sample ID: **LCS-126588** Units: **mg/Kg** Analysis Date: **27-Mar-2018 09:57**
Client ID: Run ID: **FID-10_313250** SeqNo: **4491754** PrepDate: **26-Mar-2018** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
nC6 to nC12	244.5	50	250	0	97.8	75 - 125				
>nC12 to nC28	250.1	50	250	0	100	75 - 125				
Surr: 2-Fluorobiphenyl	*20.29*	*0*	*25*	*0*	*81.2*	*70 - 130*				
Surr: Trifluoromethyl benzene	*24.63*	*0*	*25*	*0*	*98.5*	*70 - 130*				

LCSD Sample ID: **LCSD-126588** Units: **mg/Kg** Analysis Date: **27-Mar-2018 10:26**
Client ID: Run ID: **FID-10_313250** SeqNo: **4491755** PrepDate: **26-Mar-2018** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
nC6 to nC12	240.8	50	250	0	96.3	75 - 125	244.5	1.55	20	
>nC12 to nC28	247.9	50	250	0	99.2	75 - 125	250.1	0.876	20	
Surr: 2-Fluorobiphenyl	*19.54*	*0*	*25*	*0*	*78.2*	*70 - 130*	*20.29*	*3.76*	*20*	
Surr: Trifluoromethyl benzene	*23.9*	*0*	*25*	*0*	*95.6*	*70 - 130*	*24.63*	*3.01*	*20*	

MS Sample ID: **HS18031138-22MS** Units: **mg/Kg** Analysis Date: **27-Mar-2018 11:24**
Client ID: **SB05-12** Run ID: **FID-10_313250** SeqNo: **4491757** PrepDate: **26-Mar-2018** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
nC6 to nC12	223.9	39	194.7	0	115	75 - 125				
>nC12 to nC28	209.2	39	194.7	0	107	75 - 125				
Surr: 2-Fluorobiphenyl	*15.52*	*0*	*19.47*	*0*	*79.7*	*70 - 130*				
Surr: Trifluoromethyl benzene	*18.73*	*0*	*19.47*	*0*	*96.2*	*70 - 130*				

Note: See Qualifiers Page for a list of qualifiers and their explanation.

Client:	Columbia Technologies LLC
Project:	Sac + Fox
WorkOrder:	HS18031138

QC BATCH REPORT

Batch ID: **126588** **Instrument:** **FID-10** **Method:** **TX1005**

MSD Sample ID: **HS18031138-22MSD** Units: **mg/Kg** Analysis Date: **27-Mar-2018 11:53**

Client ID: **SB05-12** Run ID: **FID-10_313250** SeqNo: **4491758** PrepDate: **26-Mar-2018** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
nC6 to nC12	198.9	38	187.8	0	106	75 - 125	223.9	11.8	20	
>nC12 to nC28	195.8	38	187.8	0	104	75 - 125	209.2	6.6	20	
Surr: 2-Fluorobiphenyl	*14.84*	*0*	*18.78*	*0*	*79.0*	*70 - 130*	*15.52*	*4.44*	*20*	
Surr: Trifluoromethyl benzene	*17.74*	*0*	*18.78*	*0*	*94.5*	*70 - 130*	*18.73*	*5.43*	*20*	

The following samples were analyzed in this batch:

HS18031138-12	HS18031138-13	HS18031138-14	HS18031138-15
HS18031138-16	HS18031138-17	HS18031138-18	HS18031138-19
HS18031138-20	HS18031138-21	HS18031138-22	HS18031138-23
HS18031138-24	HS18031138-25	HS18031138-26	

Note: See Qualifiers Page for a list of qualifiers and their explanation.

Client:	Columbia Technologies LLC	**QUALIFIERS, ACRONYMS, UNITS**
Project:	Sac + Fox	
WorkOrder:	**HS18031138**	

Qualifier	Description
*	Value exceeds Regulatory Limit
a	Not accredited
B	Analyte detected in the associated Method Blank above the Reporting Limit
E	Value above quantitation range
H	Analyzed outside of Holding Time
J	Analyte detected below quantitation limit
M	Manually integrated, see raw data for justification
n	Not offered for accreditation
ND	Not Detected at the Reporting Limit
O	Sample amount is > 4 times amount spiked
P	Dual Column results percent difference > 40%
R	RPD above laboratory control limit
S	Spike Recovery outside laboratory control limits
U	Analyzed but not detected above the MDL/SDL

Acronym	Description
DCS	Detectability Check Study
DUP	Method Duplicate
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MBLK	Method Blank
MDL	Method Detection Limit
MQL	Method Quantitation Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
PDS	Post Digestion Spike
PQL	Practical Quantitaion Limit
SD	Serial Dilution
SDL	Sample Detection Limit
TRRP	Texas Risk Reduction Program

CERTIFICATIONS,ACCREDITATIONS & LICENSES

Agency	Number	Expire Date
California	2919 2016-2018	31-Jul-2018
Illinois	004112	09-May-2018
Kentucky	123043	30-Apr-2018
Louisiana	03087 2017-2017	30-Jun-2018
North Dakota	R193 2017-2017	30-Apr-2018
Oklahoma	2017-088	31-Aug-2018
Texas	T104704231-17-19	30-Apr-2018
North Carolina	624-2018	31-Dec-2018

Client: Columbia Technologies LLC
Project: Sac + Fox
Work Order: HS18031138

SAMPLE TRACKING

Lab Samp ID	Client Sample ID	Action	Date	Person	New Location
HS18031138-01	SB01-11	Login	3/23/2018 8:16:19 PM	AV	LF021
HS18031138-02	SB01-12	Login	3/23/2018 8:25:53 PM	AV	LF021
HS18031138-03	SB01-13	Login	3/23/2018 8:25:53 PM	AV	LF021
HS18031138-04	SB01-14	Login	3/23/2018 8:25:53 PM	AV	LF021
HS18031138-05	SB01-15	Login	3/23/2018 8:25:53 PM	AV	LF021
HS18031138-06	SB02-12	Login	3/23/2018 8:25:53 PM	AV	LF021
HS18031138-07	SB02-14	Login	3/23/2018 8:25:53 PM	AV	LF021
HS18031138-08	SB02-16	Login	3/23/2018 8:25:53 PM	AV	LF021
HS18031138-09	SB03-20	Login	3/23/2018 8:25:53 PM	AV	LF021
HS18031138-10	SB03-21	Login	3/23/2018 8:25:53 PM	AV	LF021
HS18031138-11	SB03-22	Login	3/23/2018 8:25:53 PM	AV	LF021
HS18031138-12	SB04-11	Login	3/23/2018 8:25:53 PM	AV	LF021
HS18031138-13	SB04-12	Login	3/23/2018 8:25:53 PM	AV	LF021
HS18031138-14	SB04-13	Login	3/23/2018 8:25:53 PM	AV	LF021
HS18031138-15	SB04-14	Login	3/23/2018 8:25:53 PM	AV	LF021
HS18031138-16	SB04-15	Login	3/23/2018 8:25:53 PM	AV	LF021
HS18031138-17	SB04-16	Login	3/23/2018 8:25:53 PM	AV	LF021
HS18031138-18	SB05-8	Login	3/23/2018 8:25:53 PM	AV	LF021
HS18031138-19	SB05-9	Login	3/23/2018 8:25:53 PM	AV	LF021
HS18031138-20	SB05-10	Login	3/23/2018 8:25:53 PM	AV	LF021
HS18031138-21	SB05-11	Login	3/23/2018 8:25:53 PM	AV	LF021
HS18031138-22	SB05-12	Login	3/23/2018 8:25:54 PM	AV	LF021
HS18031138-23	SB05-13	Login	3/23/2018 8:25:54 PM	AV	LF021
HS18031138-24	SB05-14	Login	3/23/2018 8:25:54 PM	AV	LF021
HS18031138-25	SB05-15	Login	3/23/2018 8:25:54 PM	AV	LF021
HS18031138-26	SB05-16	Login	3/23/2018 8:25:54 PM	AV	LF021

Date: 28-Mar-18

Sample Receipt Checklist

Client Name:	ColumbiaTechnologies	Date/Time Received:	**23-Mar-2018 08:50**
Work Order:	HS18031138	Received by:	**PJM**

Checklist completed by: *Jared R. Makan* (eSignature) 23-Mar-2018 (Date)

Reviewed by: *Corey Grandits* (eSignature) 26-Mar-2018 (Date)

Matrices: **Soil**

Carrier name: **FedEx Priority Overnight**

	Yes	No	
Shipping container/cooler in good condition?	☑	☐	Not Present ☐
Custody seals intact on shipping container/cooler?	☑	☐	Not Present ☐
Custody seals intact on sample bottles?	☐	☐	Not Present ☑
Chain of custody present?	☑	☐	
Chain of custody signed when relinquished and received?	☑	☐	
Chain of custody agrees with sample labels?	☑	☐	
Samples in proper container/bottle?	☑	☐	
Sample containers intact?	☐	☑	
TX1005 solids received in hermetically sealed vials?	☐	☐	N/A ☑
Sufficient sample volume for indicated test?	☑	☐	
All samples received within holding time?	☑	☐	
Container/Temp Blank temperature in compliance?	☑	☐	

Temperature(s)/Thermometer(s): 1.3c/0.7c UC/C | IR25

Cooler(s)/Kit(s): 43733

Date/Time sample(s) sent to storage: 03/23/2018 20:40

	Yes	No	
Water - VOA vials have zero headspace?	☐	☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	☐	☐	N/A ☑
pH adjusted?	☐	☐	N/A ☑

pH adjusted by:

Login Notes: Second vial for SB05-9' received cracked, sample transferred to new Tared vial, and flagged.

Client Contacted: Date Contacted: Person Contacted:

Contacted By: Regarding:

Comments:

Corrective Action:

Cincinnati, OH +1 513 733 5336
Everett, WA +1 425 356 2600
Fort Collins, CO +1 970 490 1511
Holland, MI +1 616 399 6070

Chain of Custody Form

Page 1 of 3

COC ID: 180384

Houston, TX +1 281 530 5656
Middletown, PA +1 717 944 5541
Spring City, PA +1 610 948 490
Salt Lake City, UT +1 801 266 7700

SHORT HOLDING TIME

ALS Project Manager:		ALS Work Order #:	

Customer Information		Project Information		Parameter/Method Request for Analysis	
Purchase Order		Project Name	Sac + Fox	A	TX1005_S_REV3 (5035/TPH TX1005 - *Freeze within 48 hours)
Work Order		Project Number		B	
Company Name	Columbia Technologies LLC	Bill To Company	Columbia Technologies LLC	C	
Send Report To	Scott Pieper	Invoice Attn	Scott Pieper	D	
Address	1795 Cogswell Street Suite 101	Address	1795 Cogswell Street Suite 101	E	HS18031138
				F	Columbia Technologies LLC
City/State/Zip	Rockledge,, NC 32955	City/State/Zip	Rockledge, FL 32955	G	Sac + Fox
Phone	(410) 536-9911	Phone	(410) 536-9911	H	
Fax		Fax		I	
e-Mail Address	SPieper@ColumbiaTechnologies.com	e-Mail Address	SPieper@ColumbiaTechnologies.com	J	

No.	Sample Description	Date	Time	Matrix	Pres.	# Bottles	A	B	C	D	E	F	G	H	I	J	Hold
1	SB01 -11	3/22	1221	Soil		2											
2	SB01 - 12	3/22	1226	Soil		2											
3	SB01 - 13	3/22	1231	Soil		2											
4	SB01 - 14	3/22	1236	Soil		2											
5	SB01 - 15	3/22	1240	Soil		2											
6	SB02 - 12	3/22	1255	Soil		2 AS											
7	SB02 - 14	3/22	1306	Soil		6 ~~2~~											
8	SB02 - 16	3/22	1520	Soil		2 ~~6~~ AS											
9	SB03 - 20	3/22	1326	Soil		2											
10	SB03 - 21	3/22	1333	Soil		2											

Sampler(s) Please Print & Sign: Aaron Sutton
Shipment Method: FedEx
Required Turnaround Time: (Check Box) ☐ Other ______ ☐ STD 10 Wk Days ☐ 5 Wk Days ☐ 2 Wk Days ☐ 24 Hour
Results Due Date:

Relinquished by:	Date:	Time:	Received by:
Aaron Sutton	3/22	1600	Meredith Watson

Relinquished by:	Date:	Time:	Received by (Laboratory):
Meredith Watson	3/22	1710	FedEx

Logged by (Laboratory):	Date:	Time:	Checked by (Laboratory):
	3-23-18	8:50	PM

Preservative Key: 1-HCl 2-HNO_3 3-H_2SO_4 4-NaOH 5-$Na_2S_2O_3$ 6-$NaHSO_4$ 7-Other 8-4°C 9-5035

Notes: ColumbiaTech - TPH

Cooler ID	Cooler Temp.
	UC
43733	1.3C
IR 25	CF -0.6

QC Package: (Check One Box Below)
☒ Level II Std QC ☐ TRRP Checklist
☐ Level III Std QC/Raw Data ☐ TRRP Level IV
☐ Level IV SW846/CLP
☐ Other ______

Note: 1. Any changes must be made in writing once samples and COC Form have been submitted to ALS Environmental.
2. Unless otherwise agreed in a formal contract, services provided by ALS Environmental are expressly limited to the terms and conditions stated on the reverse.
3. The Chain of Custody is a legal document. All information must be completed accurately.

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Everett, WA +1 425 356 2600 | Holland, MI +1 616 399 6070 | Middletown, PA +1 717 944 5541 | Salt Lake City [illegible] +1 801 266 7[illegible] | [illegible]80

Chain of Custody Form

Page 2 of 3

COC ID: 180380

SHORT HOLDING TIME

ALS Project Manager:		ALS Work Order #:	

Customer Information		Project Information		Parameter/Method Request for Analysis	
Purchase Order		Project Name	Sac + Fox	A	TX1005_S_REV3 (5035/TPH TX1005 - *Freeze within 48 hours)
Work Order		Project Number		B	
Company Name	Columbia Technologies LLC	Bill To Company	Columbia Technologies LLC	C	
Send Report To	Scott Pieper	Invoice Attn	Scott Pieper	D	
Address	1795 Cogswell Street Suite 101	Address	1795 Cogswell Street Suite 101	E F	HS18031138 Columbia Technologies LLC Sac + Fox
City/State/Zip	Rockledge,, NC 32955	City/State/Zip	Rockledge, FL 32955	G	
Phone	(410) 536-9911	Phone	(410) 536-9911	H	
Fax		Fax		I	
e-Mail Address	SPieper@ColumbiaTechnologies.com	e-Mail Address	SPieper@ColumbiaTechnologies.com	J	

No.	Sample Description	Date	Time	Matrix	Pres.	# Bottles	A	B	C	D	E	F	G	H	I	J	Hold
1	SB03 - 22	3/22	1339	Soil		2											
2	SB04 - 11	3/22	1405	Soil		2											
3	SB04 - 12	3/22	1425	Soil		2											
4	SB04 - 13	3/22	1410	Soil		2											
5	SB04 - 14	3/22	1415	Soil		2											
6	SB04 - 15	3/22	1420	Soil		2											
7	SB04 - 16	3/22	1430	Soil		2											
8	SB05 - 8	3/22	1510	Soil		2											
9	SB05 - 9	3/22	1515	Soil		2											
10	SB05 - 10	3/22	1447	Soil		2											

Sampler(s) Please Print & Sign: Aaron Sutton (signature) Aaron Sutton

Shipment Method: FedEx

Required Turnaround Time: (Check Box) ☐ Other ____ ☐ STD 10 Wk Days ☐ 5 Wk Days ☐ 2 Wk Days ☐ 24 Hour

Results Due Date:

Relinquished by:	Date:	Time:	Received by:
Aaron Sutton	3/22	1600	Meredith Watson

Relinquished by:	Date:	Time:	Received by (Laboratory):
Meredith Watson	3/22	1510	FedEx

Logged by (Laboratory):	Date:	Time:	Checked by (Laboratory):
	3-23-18	8:50	PM

Preservative Key: 1-HCl 2-HNO_3 3-H_2SO_4 4-NaOH 5-$Na_2S_2O_3$ 6-$NaHSO_4$ 7-Other 8-4°C 9-5035

Notes: ColumbiaTech - TPH

Cooler ID	Cooler Temp.

QC Package: (Check One Box Below)
- [X] Level II Std QC
- [ ] Level III Std QC/Raw Date
- [ ] Level IV SW846/CLP
- [ ] Other ____
- [ ] TRRP Checklist
- [ ] TRRP Level IV

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Everett, WA +1 425 356 2600 | Holland, MI +1 616 399 6070 | Middletown, PA +1 717 944 5541 | Salt ... +1 80... | ..., PA ...17 505 5280

Chain of Custody Form

SHORT HOLDING TIME

COC ID: 180381

ALS Project Manager: | ALS Work Order #:

Customer Information		Project Information		Parameter/Method Request for Analysis	
Purchase Order		Project Name	Sac + Fox	A	TX1005_S_REV3 (5035/TPH TX1005 - *Freeze within 48 hours)
Work Order		Project Number		B	
Company Name	Columbia Technologies LLC	Bill To Company	Columbia Technologies LLC	C	
Send Report To	Scott Pieper	Invoice Attn	Scott Pieper	D	
Address	1795 Cogswell Street Suite 101	Address	1795 Cogswell Street Suite 101	E	
				F	HS18031138
City/State/Zip	Rockledge,, NC 32955	City/State/Zip	Rockledge, FL 32955	G	Columbia Technologies LLC Sac + Fox
Phone	(410) 536-9911	Phone	(410) 536-9911	H	
Fax		Fax		I	
e-Mail Address	SPieper@ColumbiaTechnologies.com	e-Mail Address	SPieper@ColumbiaTechnologies.com	J	

No.	Sample Description	Date	Time	Matrix	Pres.	# Bottles	A	B	C	D	E	F	G	H	I	J	Hold
1	SB05-11	3/22	1451	Soil		2											
2	SB05-12	3/22	1455	Soil		6											
3	SB05-13	3/22	1500	Soil		2											
4	SB05-14	3/22	1506	Soil		2											
5	SB05-15	3/22	1442	Soil		2											
6	SB05-16	3/22	1445	Soil		2											
7																	
8																	
9																	
10																	

Sampler(s) Please Print & Sign: Aaron Sutton [signature] Aaron Sutton

Shipment Method: FedEx

Required Turnaround Time: (Check Box) ☐ Other ____ ☐ STD 10 Wk Days ☐ 5 Wk Days ☐ 2 Wk Days ☐ 24 Hour

Results Due Date:

Relinquished by:	Date:	Time:	Received by:
Aaron Sutton	3/22	1600	Meredith Watson
Meredith Watson	3/22/18	1710	Received by (Laboratory): FedEx
Logged by (Laboratory):	3-23-18	8:50	Checked by (Laboratory): PM

Notes: ColumbiaTech - TPH

Cooler ID	Cooler Temp.

QC Package: (Check One Box Below)
☒ Level II Std QC ☐ TRRP Checklist
☐ Level III Std QC/Raw Date ☐ TRRP Level IV
☐ Level IV SW846/CLP
☐ Other ____

Preservative Key: 1-HCl 2-HNO_3 3-H_2SO_4 4-NaOH 5-$Na_2S_2O_3$ 6-$NaHSO_4$ 7-Other 8-4°C 9-5035

Note: 1. Any changes must be made in writing once samples and COC Form have been submitted to ALS Environmental.
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3. The Chain of Custody is a legal document. All information must be completed accurately.

ALS
10450 Stancliff Rd., Suite 210
Houston, Texas 77099
Tel. +1 281 530 5656
Fax. +1 281 530 5887
43733

CUSTODY SEAL
Date: 3/22/18 Time: 1716
Name: Meredith Watson
Company: terranext

Seal Broken By: PM
Date: 3-23-18

ALS
10450 Stancliff Rd., Suite 210
Houston, Texas 77099
Tel. +1 281 530 5656
Fax. +1 281 530 5887
43733

CUSTODY SEAL
Date: 3/22/18 Time: 1716
Name: Meredith Watson
Company: terranext

Seal Broken By: PM
Date: 3-23-18

FedEx
TRK# 0221 7376 9753 4247

FRI - 23 MAR 10:30A
PRIORITY OVERNIGHT

AB SGRA 43733

77099
TX-US
IAH

FID 5200297 22MAR18 TOPA 546C1/07F5/0C0A

List of Symbols, Abbreviations, and Acronyms

Symbol or Abbreviation	Definition
CSM	**Conceptual Site Model.** A **CSM** is a method to describe what is known or can be inferred about a site for the purpose of making a decision. A CSM generally will address physical, chemical and biological systems; contaminant release and transport; societal issues; policy, land use, and exposures.
CVOC	**Chlorinated Volatile Organic Contaminant.** A **VOC** containing chlorine atoms; typically, a cleaning solvent.
DPT	**Direct-Push Technology** (DPT) refers to a group of techniques used for subsurface investigation by driving, pushing and/or vibrating small-diameter rods into the ground.
ECD	**Electron Capture Detector.** An **ECD** is a device for detecting electron-absorbing components (high electronegativity) such as halogenated compounds in a gas through the attachment of electrons via electron capture ionization.
DNAPL	**Dense Non-Aqueous Phase Liquid.** A **DNAPL** is a denser-than-water NAPL, i.e. a liquid that is both denser than water and is immiscible in or does not dissolve in water.
HPT	**Hydraulic Profiling Tool**. The **HPT** is a logging **tool** that measures the pressure required to inject a flow of water into the soil as the probe is advanced into the subsurface. In addition to measurement of injection pressure, the HPT can also be used to measure hydrostatic pressure under the zero flow condition.
LCSM	**LNAPL Conceptual Site Model.** A **LCSM** is a conceptual site model focused on the release and transport of LNAPL contaminants.
LIF	**Laser-induced fluorescence** is a spectroscopic method in which an atom or molecule is excited to a higher energy level by the absorption of laser light followed by spontaneous emission of light.
LNAPL	**Light Non-Aqueous Phase Liquids** are groundwater contaminants that are not soluble in water and have lower density than water, in contrast to a **DNAPL** which has higher density than water.

Symbol or Abbreviation	Definition
PHC	**Petroleum Hydrocarbons.** The presence of petroleum hydrocarbon fuels in any phase. **(PHC).**
PID	**Photo Ionization Detector.** In a **PID** high-energy photons to break molecules into positively charged ions. The **PID** will only respond to components that have ionization energies at or below the energy of the photons produced by the **PID** lamp.
SPOC	**Shock Protected Optical Cavity**. The **SPOC** is the component of the LIF system that contains the mirror and sapphire window for proper alignment of the laser beam.
TCE	**Trichloroethylene.** The chemical compound **TCE** is a halocarbon commonly used as an industrial solvent. It is a clear non-flammable liquid with a sweet smell.
UST	**Underground Storage Tank.** Under Federal law **UST** means any one or combination of tanks including connected underground pipes that is used to contain regulated substances, and the volume of which including the volume of underground pipes is 10 percent or more beneath the surface of the ground. This does not include, among other things, any farm or residential tank of 1,100 gallons or less capacity used for storing motor fuel for noncommercial purposes, tanks for storing heating oil for consumption on the premises, or septic tanks.
UVOST®	**Ultraviolet Optical Scanning Tool®.** A **LIF** is a tool that uses laser light in the ultraviolet spectrum to excite fluorescent molecules that exist in the vast majority of hazardous non-aqueous phase liquids (NAPLs) such as petroleum fuels/oils, coal tars, and creosotes.
VOC	**Volatile organic compounds** (**VOCs**) are organic chemicals that have a high vapor pressure at ordinary room temperature. Their high vapor pressure results from a low boiling point, which causes large numbers of molecules to evaporate or sublimate from the liquid or solid form of the compound and enter the surrounding air, a trait known as volatility.
XSD	**Halogen Specific Detector.** The **XSD** was developed for the selective detection of halogen-containing compounds.

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Historical Indications of Residual LNAPL

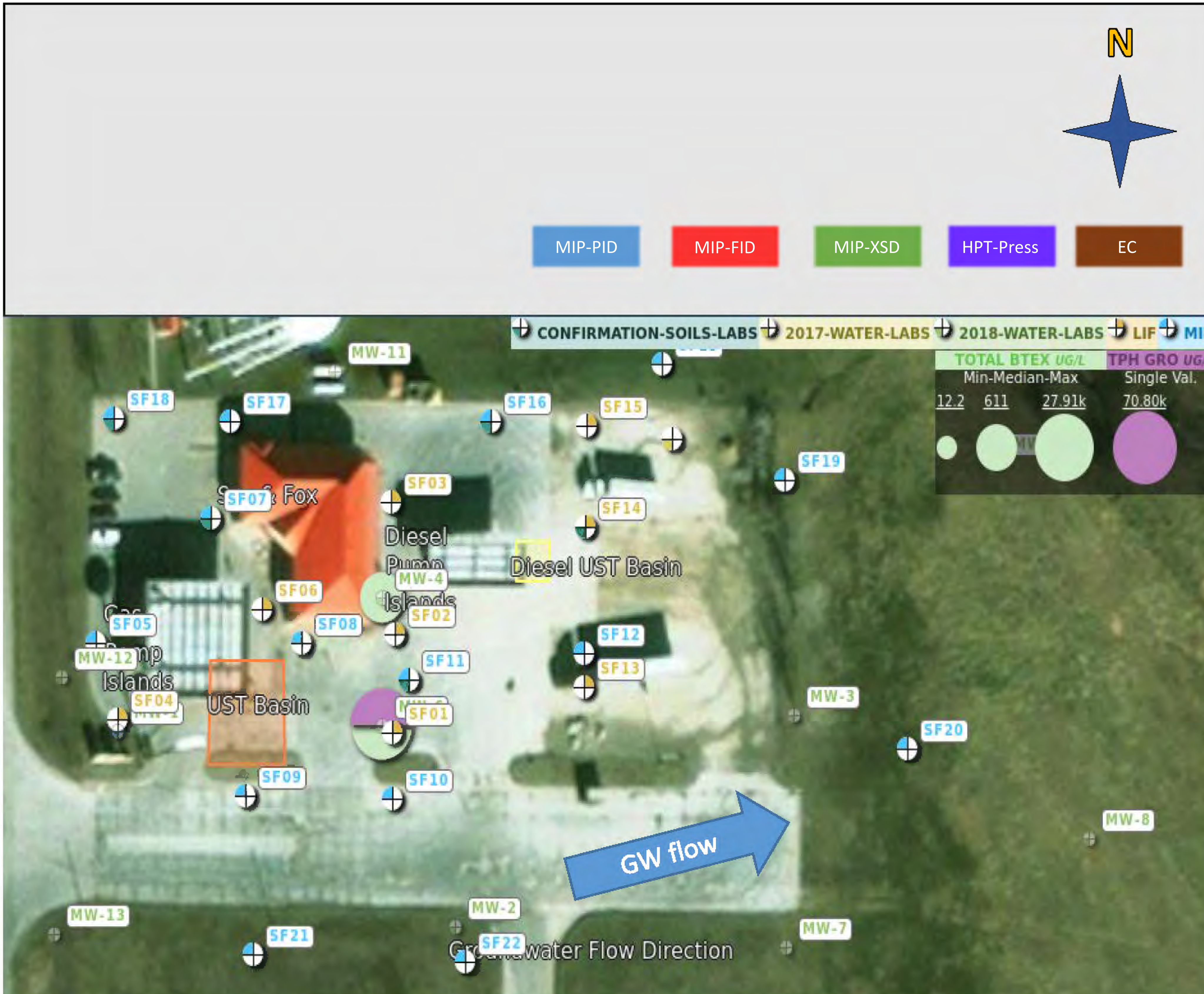
Figure 1

Sac & Fox Truck Stop
Powhattan KS

March 2018

High-Resolution Assessment

COLUMBIA TECHNOLOGIES



Survey Station Locations

Figure 2

Sac & Fox Truck Stop
Powhattan KS

March 2018

High-Resolution Assessment

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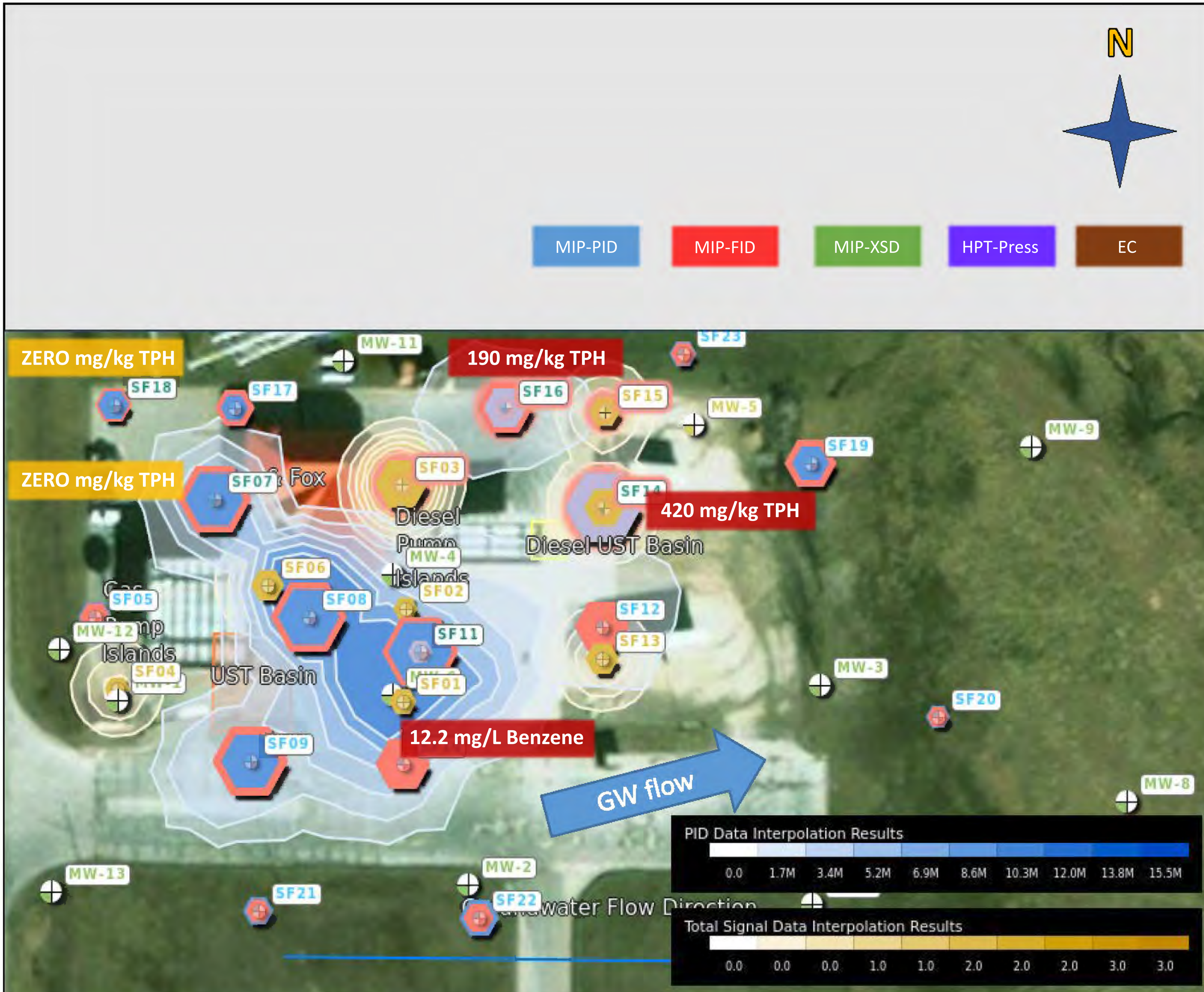


Residual LNAPL Footprint

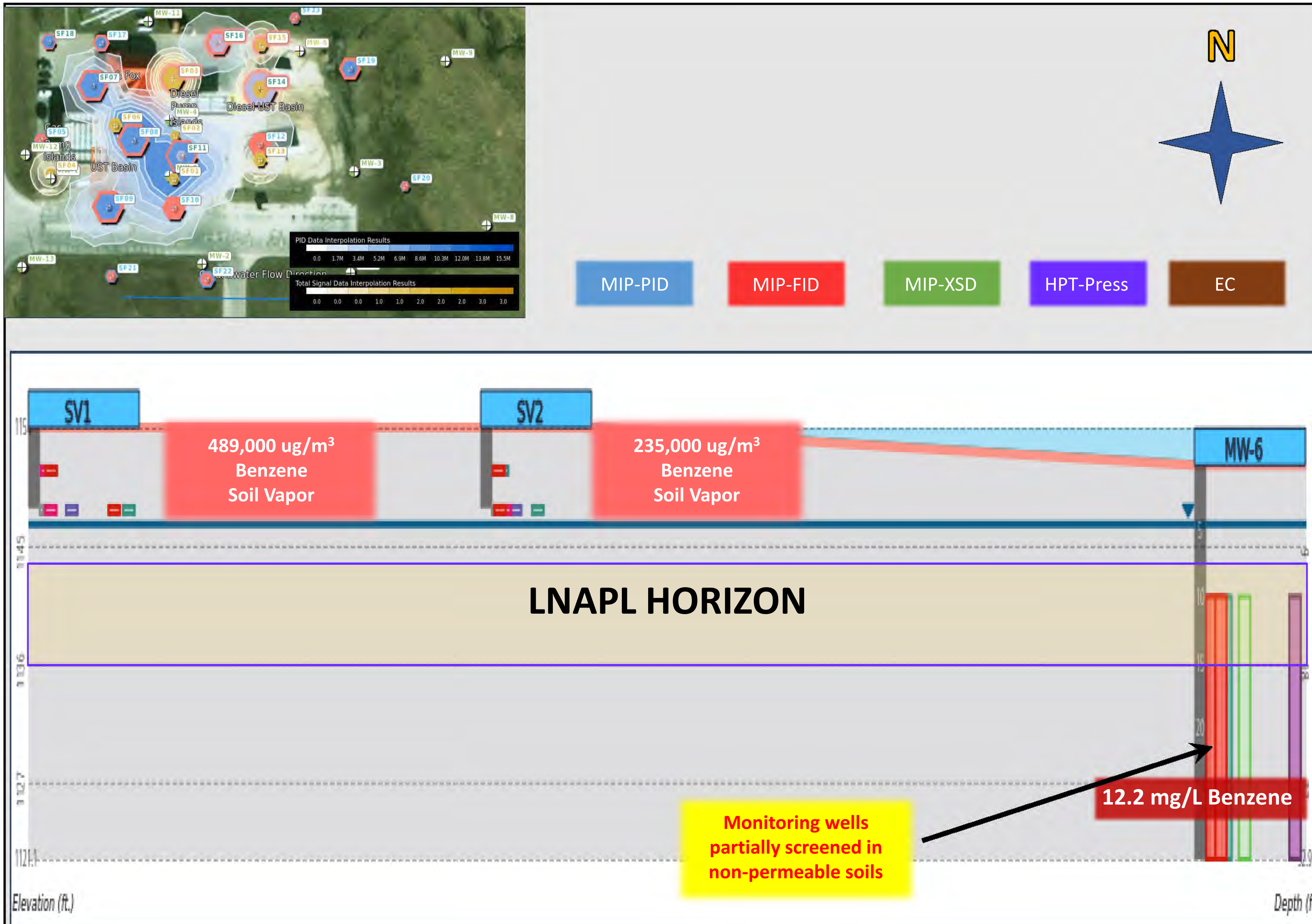
Figure 3

Sac & Fox Truck Stop
Powhattan KS

March 2018

High-Resolution Assessment

COLUMBIA TECHNOLOGIES



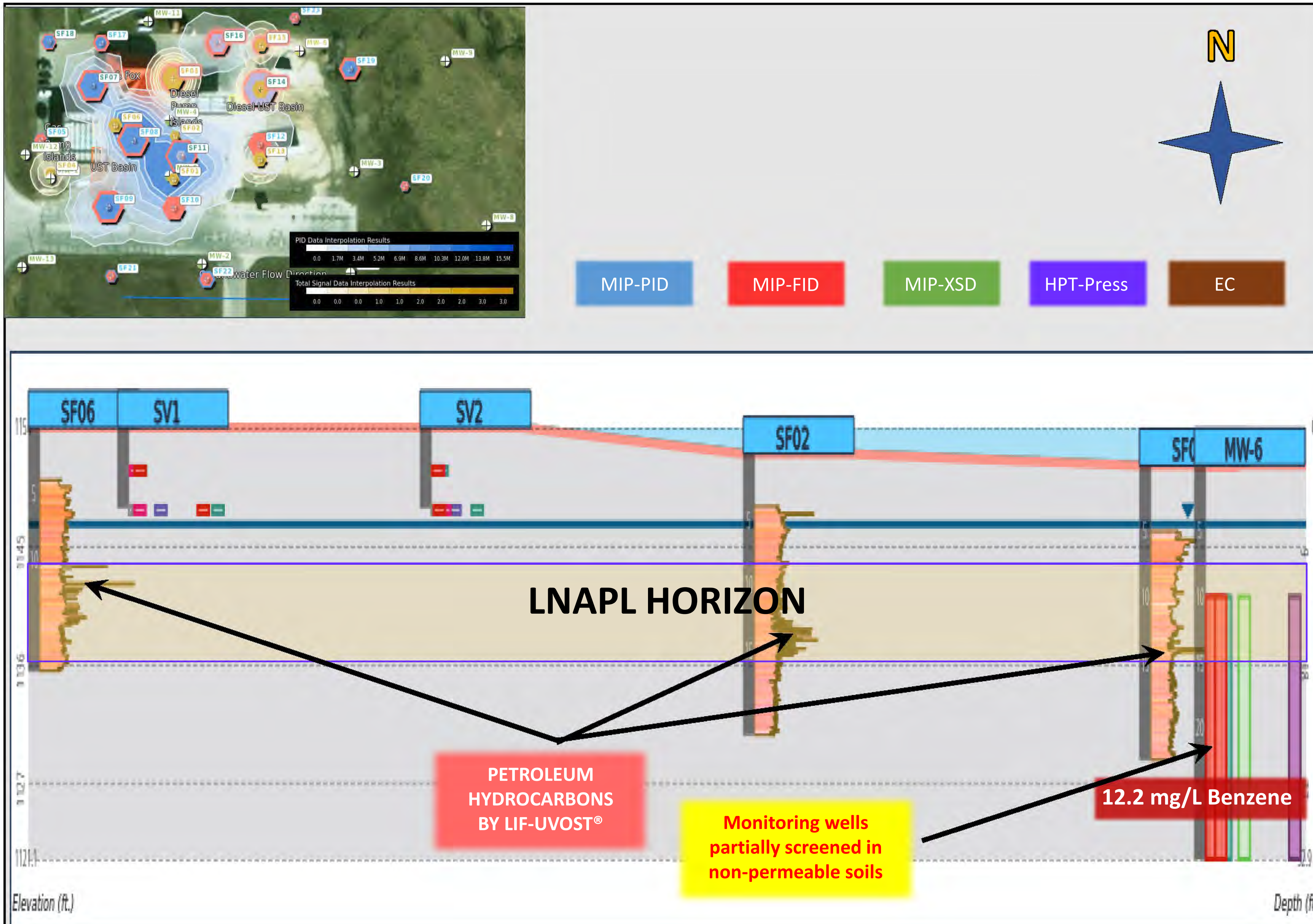
Soil Vapor Results in LNAPL Footprint

Figure 4

Sac & Fox Truck Stop
Powhattan KS

March 2018

High-Resolution Assessment



LNAPL Footprint by LIF-UVOST®

Figure 5

Sac & Fox Truck Stop
Powhattan KS

March 2018

High-Resolution Assessment

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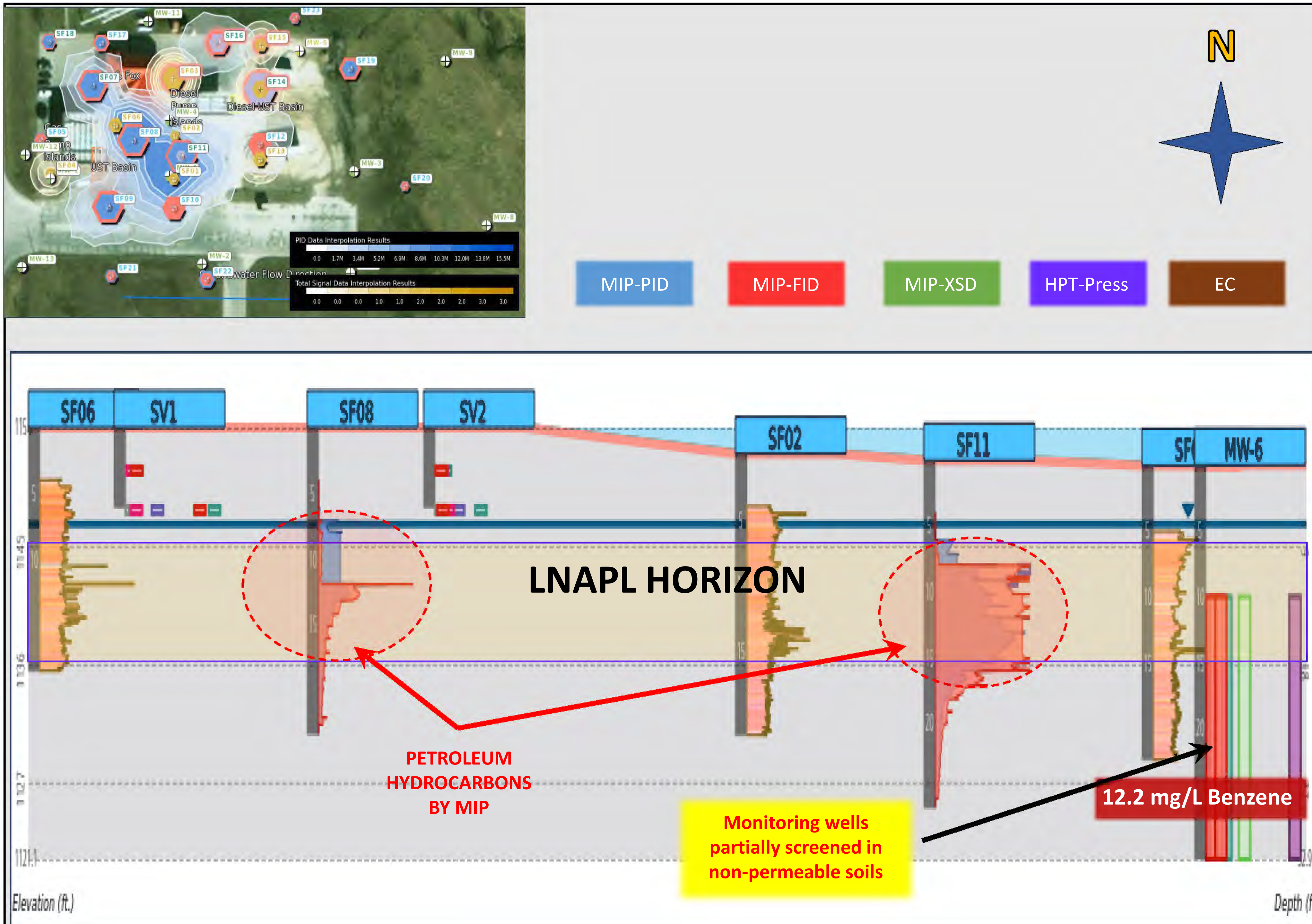

LNAPL Footprint by MIP-PID

Figure 6

Sac & Fox Truck Stop
Powhattan KS

March 2018

High-Resolution Assessment

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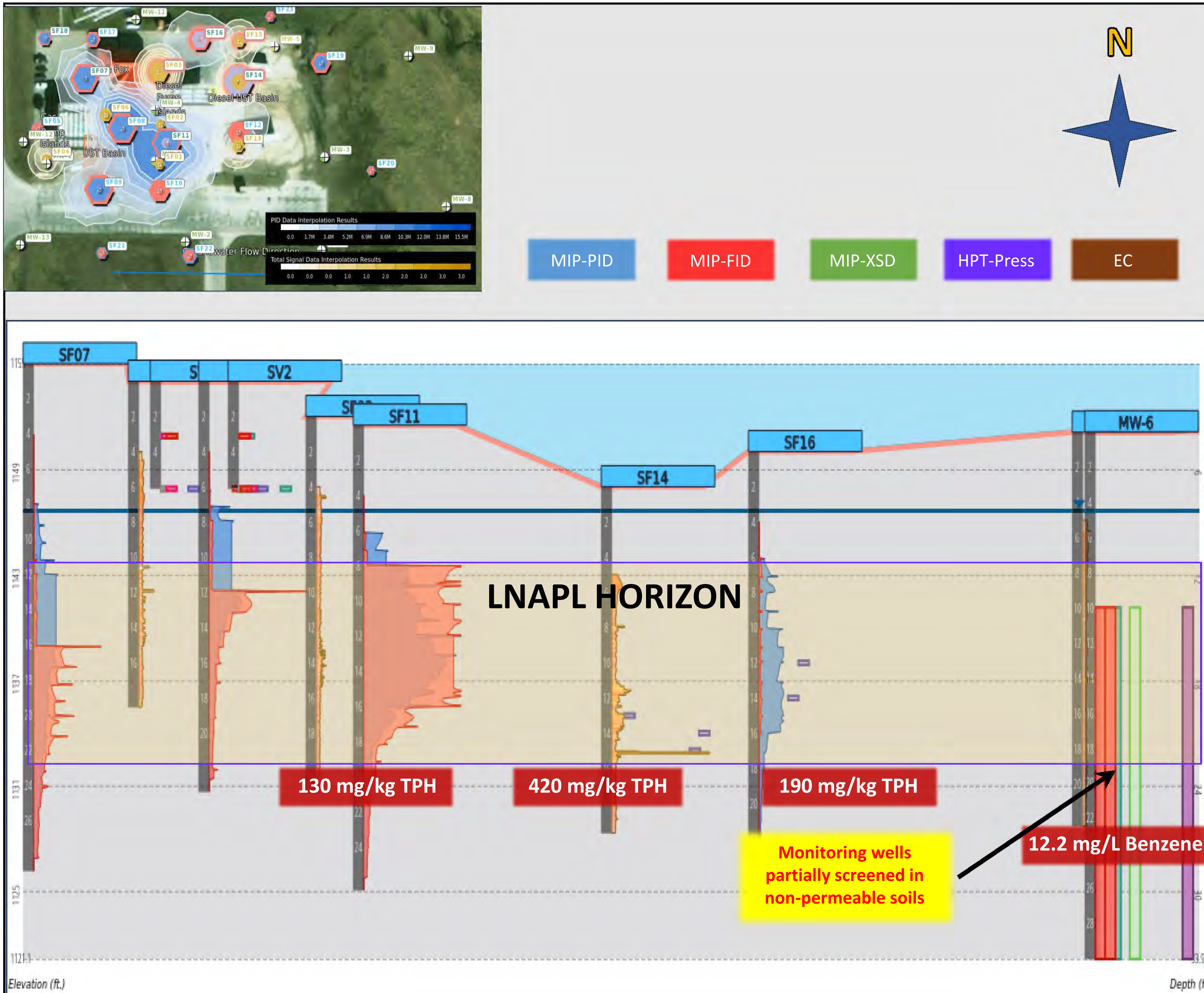

LNAPL Footprint by Soil Sampling

Figure 7

Sac & Fox Truck Stop
Powhattan KS

March 2018

High-Resolution Assessment

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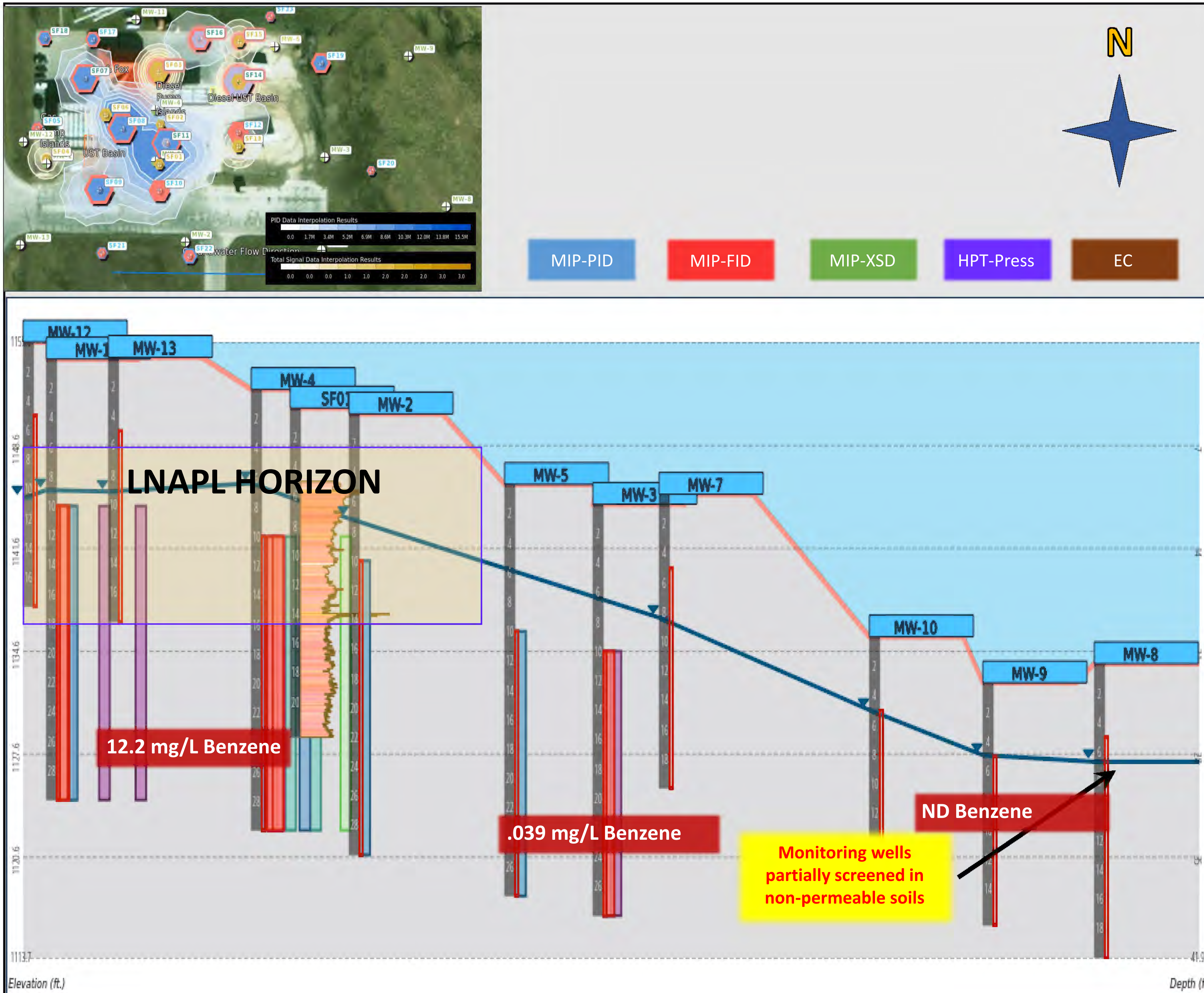

LNAPL Footprint by GW Monitoring Wells

Figure 8

Sac & Fox Truck Stop
Powhattan KS

March 2018

High-Resolution Assessment

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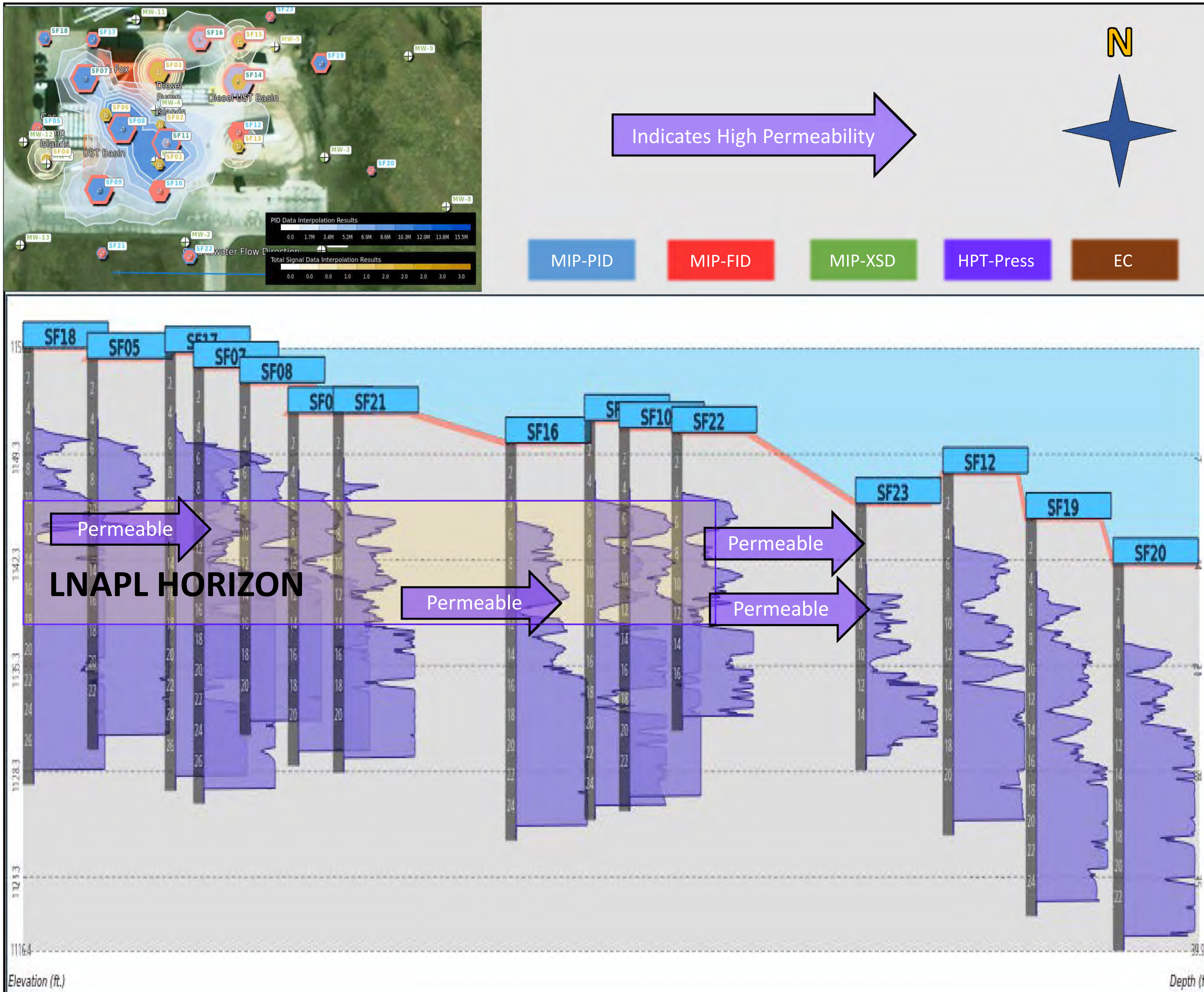

LNAPL Footprint vs Soil Permeability

Figure 9

Sac & Fox Truck Stop
Powhattan KS

March 2018

High-Resolution Assessment

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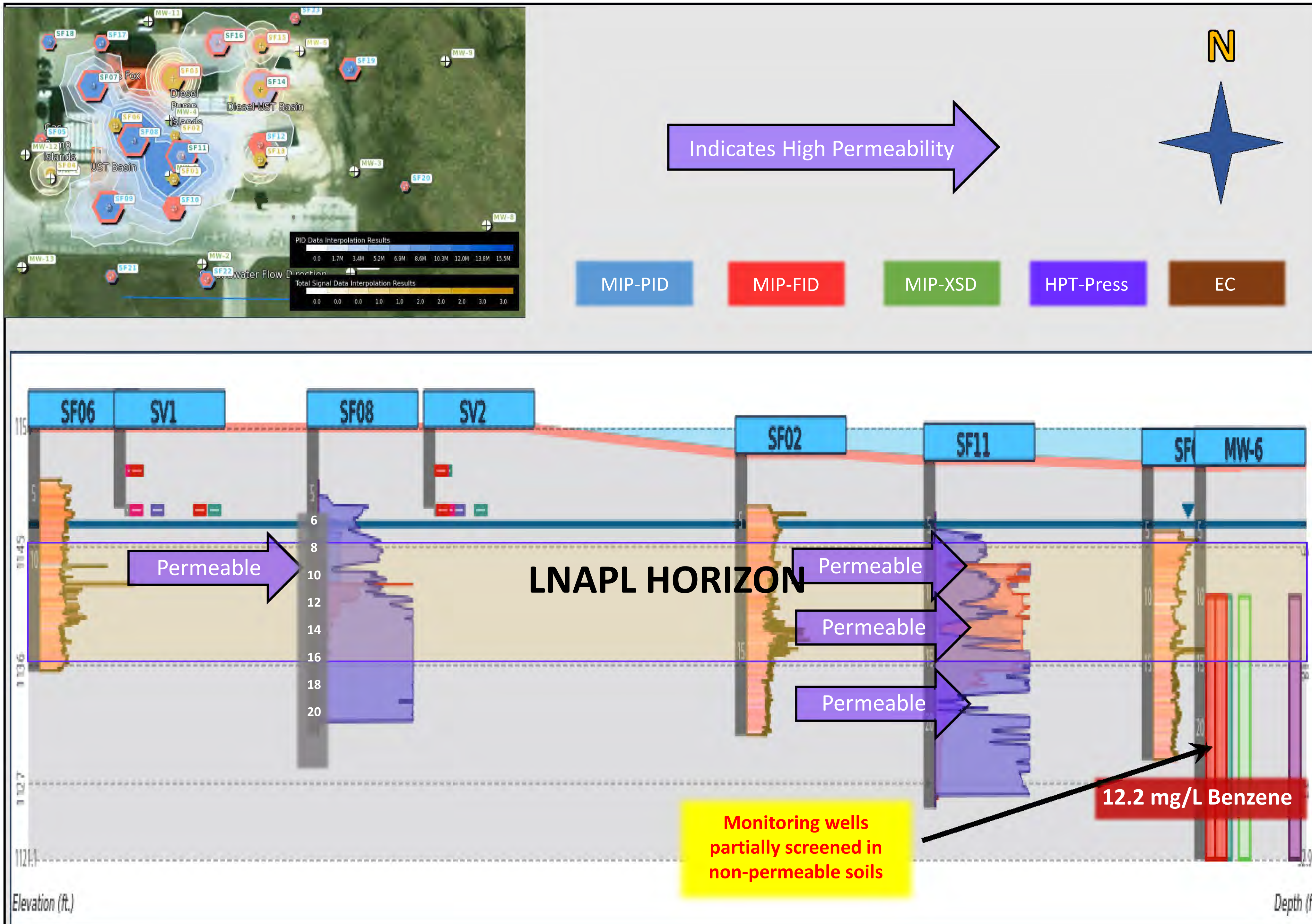

LNAPL Footprint by MIP-PID & FID

Figure 10

Sac & Fox Truck Stop
Powhattan KS

March 2018

High-Resolution Assessment

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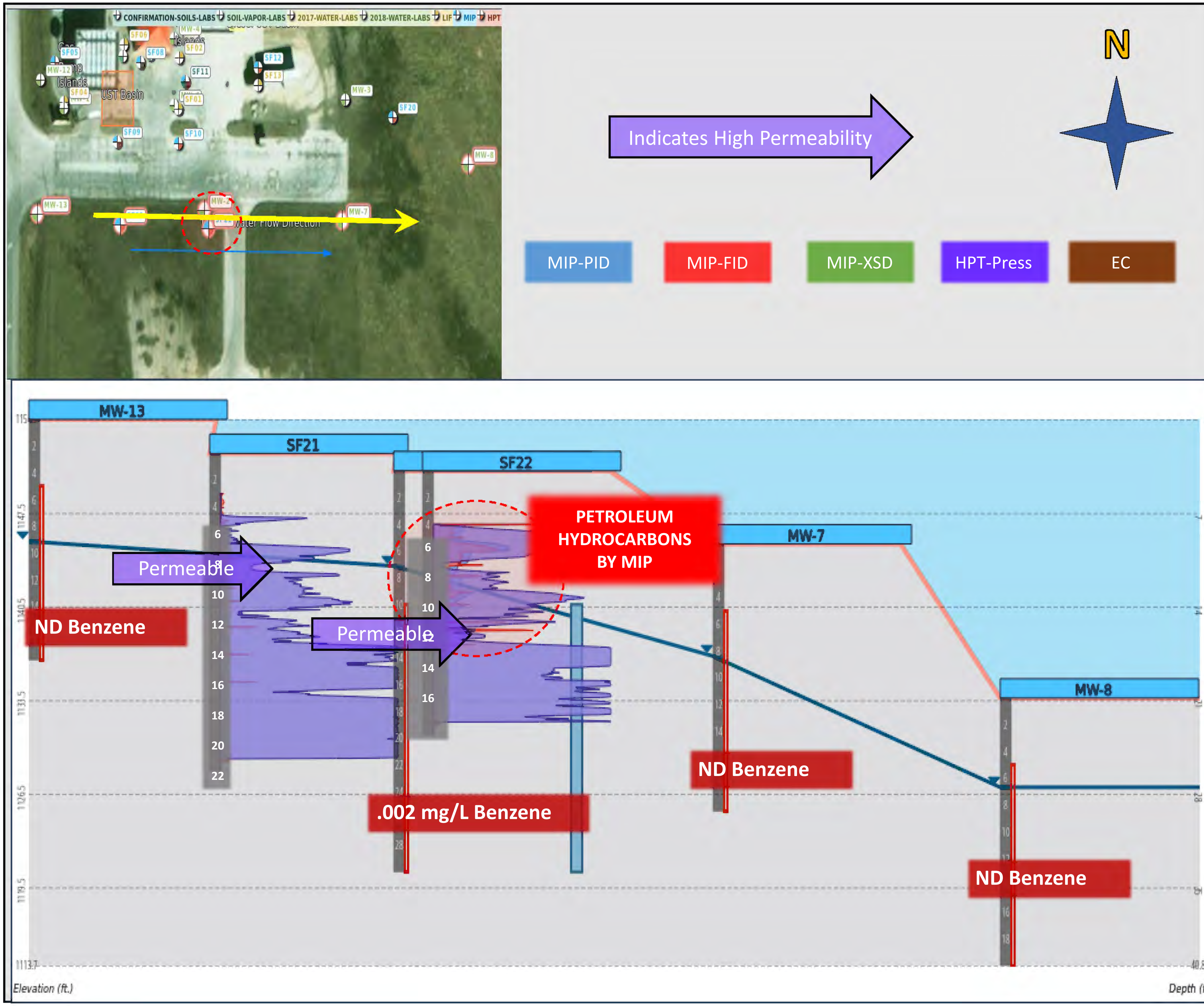

Transect at Southern Boundary

Figure 11

Sac & Fox Truck Stop
Powhattan KS

March 2018

High-Resolution Assessment

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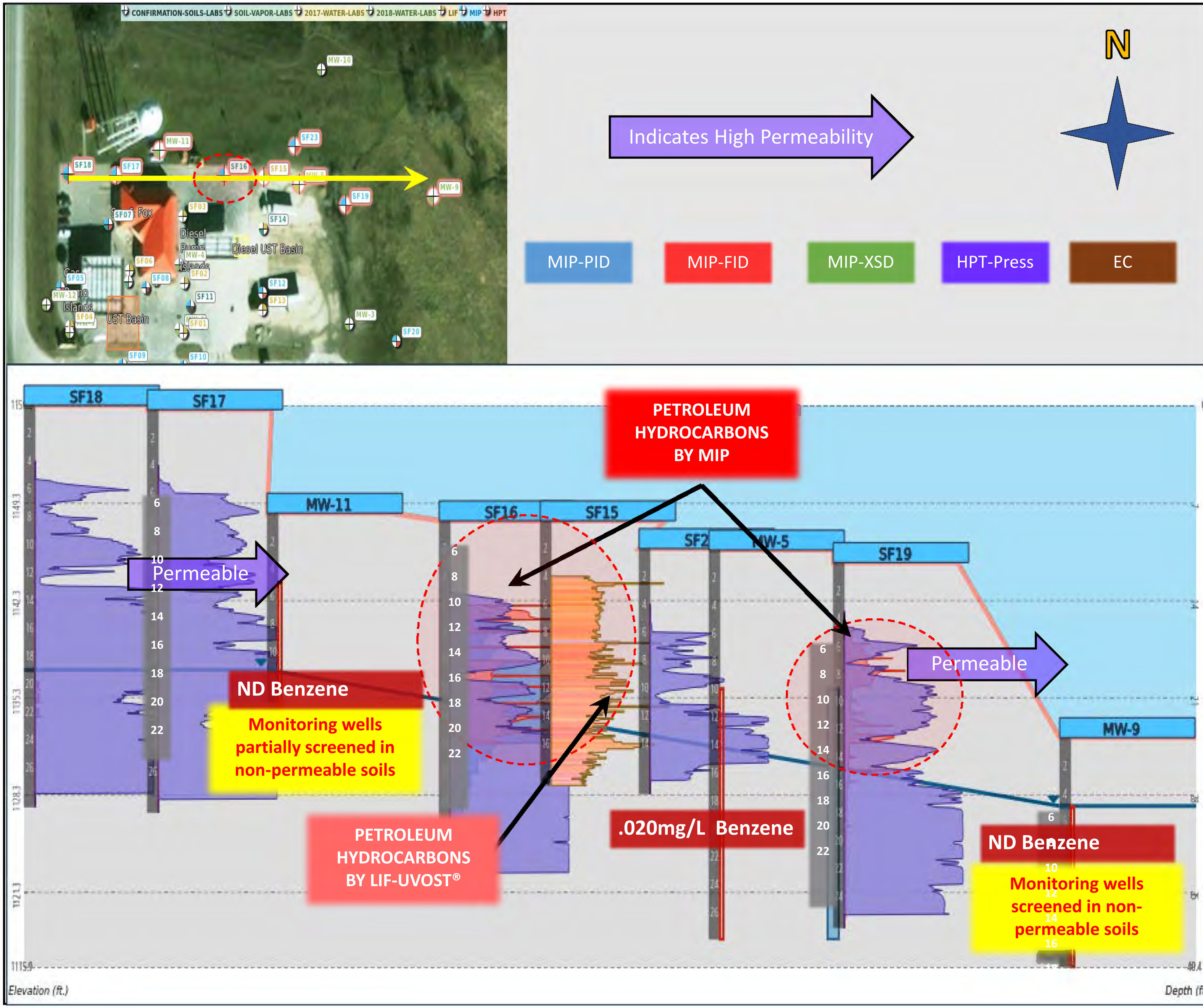

Transect at Northern Boundary

Figure 12

Sac & Fox Truck Stop
Powhattan KS

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High-Resolution Assessment

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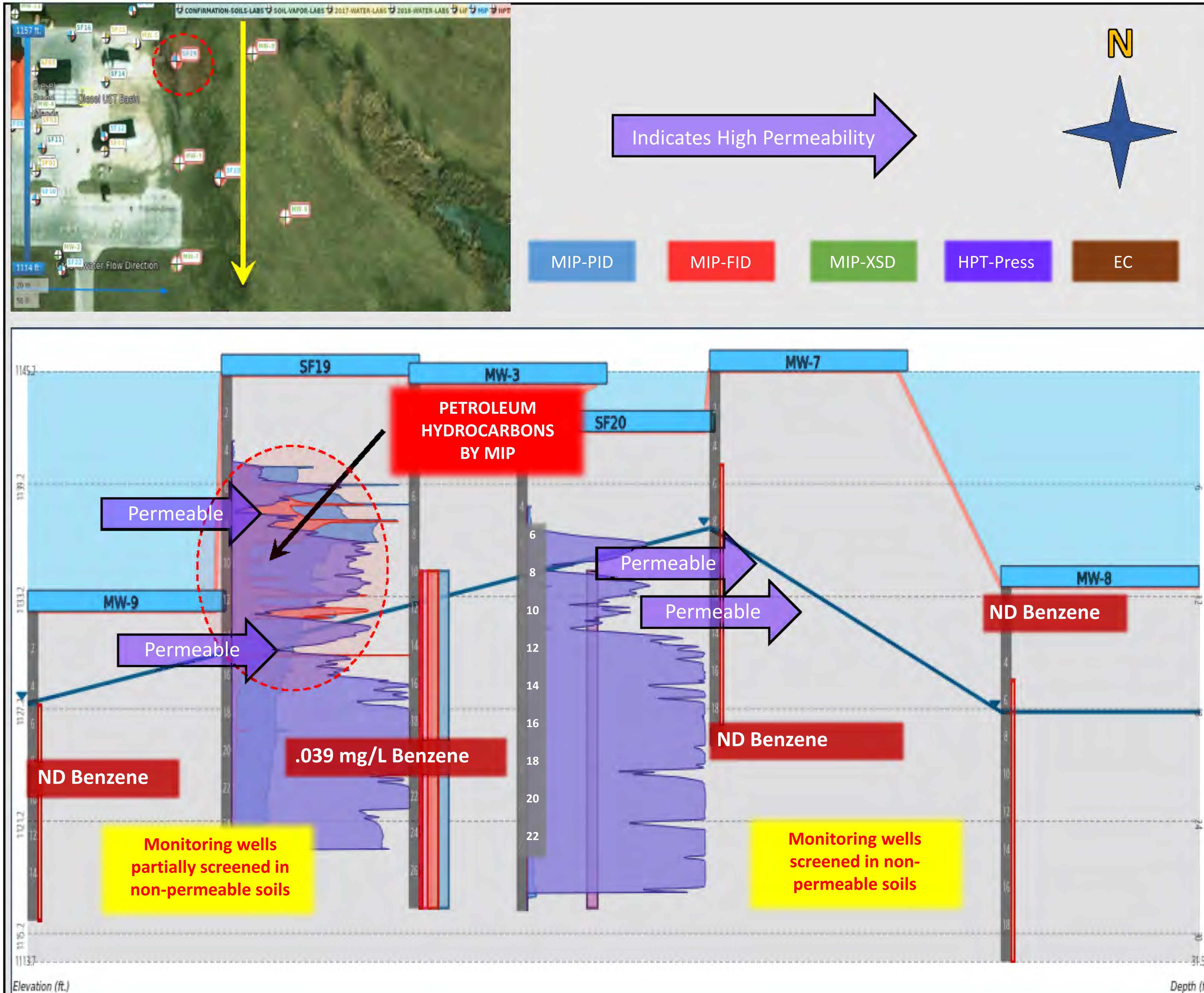


Transect at Eastern Boundary

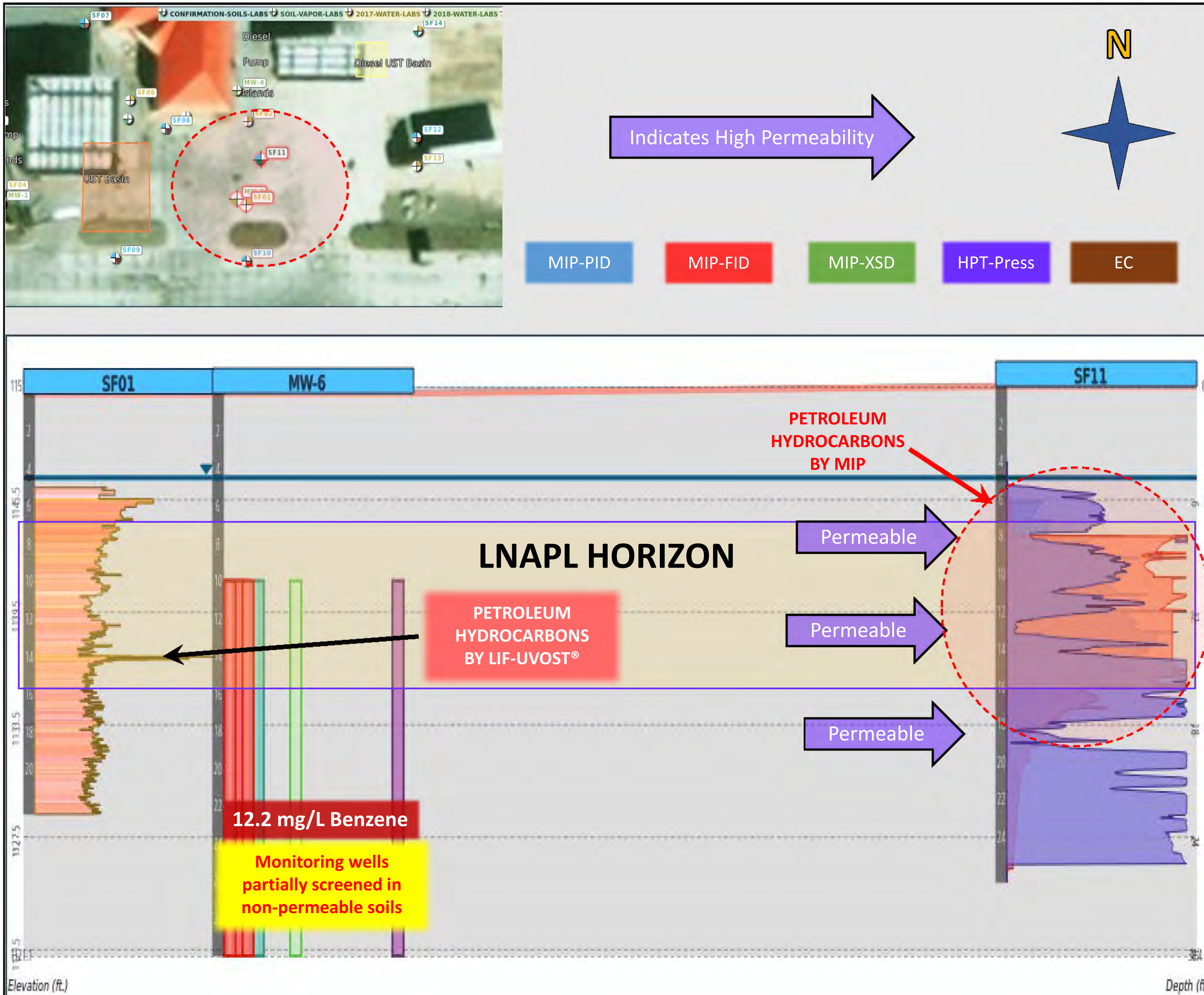
Figure13

Sac & Fox Truck Stop
Powhattan KS

March 2018

High-Resolution Assessment

COLUMBIA TECHNOLOGIES



MW-6 Cluster

Figure 14

Sac & Fox Truck Stop
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High-Resolution Assessment

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